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Paleogeographic evolution during the Eocene Upper Wilcox in the Houston Embayment with consideration of the Yoakum Canyon fill

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Paleogeographic evolution during the Eocene Upper Wilcox in the Houston Embayment with consideration of the Yoakum Canyon fill

by

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Dedication

I would like to dedicate this work to my grandparents, parents, and sister.

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I wish to express my sincere thanks to my supervisors, Dr. Cornel Olariu and Dr. Ronald Steel. Their tireless efforts and teaching were instrumental to my development as a graduate student, scientist, and to the eventual completion of this thesis. I also thank Dr. David Mohrig for his guidance, instruction, and work on this thesis.

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Abstract

Paleogeographic evolution during the Eocene Upper Wilcox in the Houston Embayment with consideration of the Yoakum Canyon fill

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The University of Texas at Austin, 2015

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The Eocene Upper Wilcox clastic wedge represents the second major pulse of terrigenous material into the Gulf of Mexico basin. Recent interest in the Wilcox has been reinvigorated by the drilling of the Baha prospect in 2001, and the associated discovery of 2.5 billion barrels of producible oil in deepwater Wilcox aged turbidite deposits. To better characterize and understand the deepwater deposits, research in the delivery systems that transported sediment from the Laramide uplift to the deep Gulf of Mexico is required, with a special focus on the Wilcox shelf margin. This study incorporates over 300 well logs, and outcrop to analyze the Upper Wilcox shelf deposits in the Houston Embayment. The area of this study extends from the outcrop belt in the north-northwest of the embayment down into the subsurface to the limit of down dip well control, around 150 km to the south-southeast. From west to east it extends from Gonzales County to Grimes County, around 200 km. In the Houston embayment the Upper Wilcox was previously interpreted as mainly being fluvial deposits that prograded across the relatively stable substrate provided by the underlying delta complexes of the Lower Wilcox. Previous authors have asserted that the Yoakum Canyon (Middle Wilcox) in the southwest of the field area had its entire 3,000' filled with prodelta muds prior to the progradation of the Upper Wilcox. However, the present work shows that upper reaches of the Yoakum Canyon were filled by the sandstone units of the Upper Wilcox. Paleogeography maps, generated by differentiating between marine and terrestrial log signatures identify five distinct sequences in the Upper Wilcox. Each sequence shows linear sand trends across the shelf, generally in a north to south direction. A majority of sand was deposited in sequences three and four, through aggradation in the east and progradation in the west over the Yoakum Canyon region. The corresponding shorelines for sequences one through four remain largely pinned along the inherited shelf edge of the Lower Wilcox in the east, whereas the shorelines strongly prograde in the southwest over the Yoakum Canyon. With this new interpretation, that the Yoakum Canyon was not completely filled at the time of Upper Wilcox deposition, it is possible that the canyon delivered 2.86-7.15*106t/yr of sediment to the deepwater reservoirs. Outcrop measurements of cross strata, taken in Bastrop County, confirm the fluvial well log interpretation and provided a base for the volume calculations.

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Introduction

The Wilcox group (late Paleocene/ early Eocene) was the first main pulse of clastic sediment to prograde from about 60 Ma to 49 Ma into the Gulf of Mexico after its Tertiary opening (Figure 1) (Edwards, 1981; Winker, 1982). The Wilcox came into importance as an early gas producer and was identified to span from Alabama to the Burgos Basin in northeastern Mexico (Fisher & McGowen, 1967; Galloway, Ganey-Curry, Li, & Buffler, 2000). The environments of deposition ranged from non-marine with updip fluvial channel sandstones to continental slope undifferentiated mudstones and deep water fans (Fisher & McGowen, 1967; Xue & Galloway, 1995; Zarra, Meyer, & Neal, 2005).

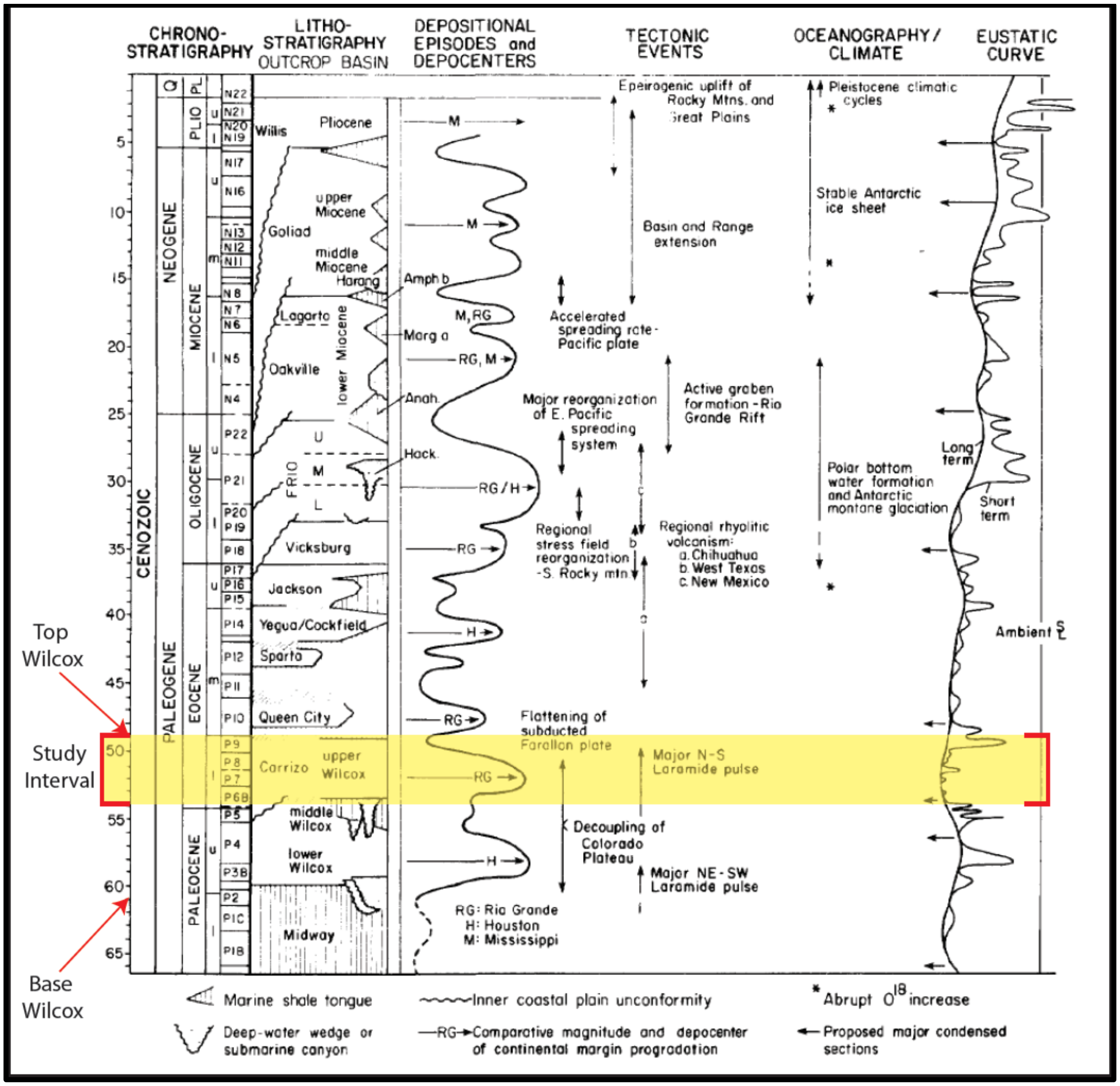


Figure 1: Stratigraphy of the depositional units in the Gulf of Mexico. The Upper Wilcox is highlighted in yellow (modified from Galloway, 1989).

Study of the Wilcox has traditionally been driven by the economic onshore gas trend, estimated to have contained 30 TCF of gas, most of which has been produced over the last 80 years (Hargis, 1962; Zarra, 2007). Recent drilling activity of the Lower Tertiary trend in the deepwater Gulf of Mexico has identified significant economically viable reservoirs spurring new interest and research. The identified Wilcox age (late-

Paleocene to early-Eocene) turbidite successions reach over 2000 m (6000 ft) thick in places and extend for over 88,060 km2 (34,000 mi2) (Figure 2) (Rains, Zarra, & Meyer, 2007). Potential reserves of recoverable oil are estimated to be at least 2.5 billion barrels (Zarra, 2007). The major challenge for companies pursuing these tempting targets is predicting the locations of deposits with favorable reservoir conditions including but not limited to high net to gross, porosity, and reservoir interconnectedness. Traditionally, elucidating these values is aided by following previously mapped onshore trends across the shelf and slope into the deepwater. Unfortunately, due to the excessive depths at which the Wilcox rocks are located on the shelf and slope, the deepwater Wilcox aged targets are over 370 km (230mi) basinward from the nearest well log data (Zarra, 2007). Usually seismic lines can be used to track stratigraphic trends into the basin but the complex salt tectonics across the slope disrupt and hinder attempts to trace the Wilcox trend into the deepwater.

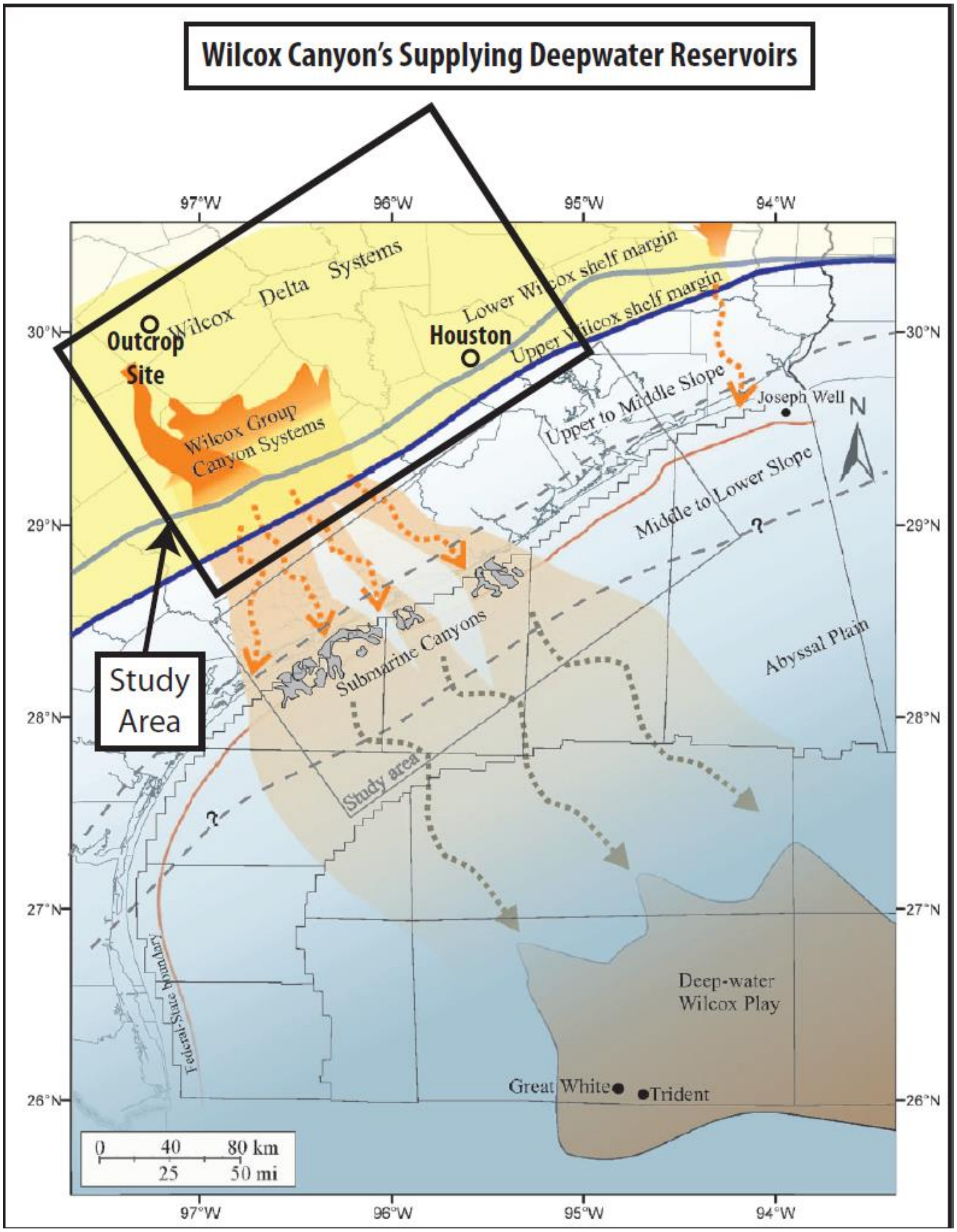


Figure 2: An overview of the deepwater system of interest in the Gulf of Mexico from the shelf to the deep basin. The Yoakum Canyon is in orange in the study area. The brown deepwater Wilcox Play shows the massive distribution and relative unconstrained nature of the deposit (modified from (McDonnell, Loucks, & Galloway, 2008)

In the absence of directly tracing fairways into a basin, a relatively new approach, Source-to-Sink (S2S) study, has been used to help model and predict basin accumulations of sediment via the study of the source catchments. Source-to-Sink studies begin in the erosional catchment areas and follow the yielded sediment's journey to the shoreline, shelf and deepwater areas beyond where they use mass balance considerations to infer sediment load and lithologies that have been partitioned down to the deepwater reservoirs (Figure 3) (Sømme et al., 2009; Petter et al., 2012).

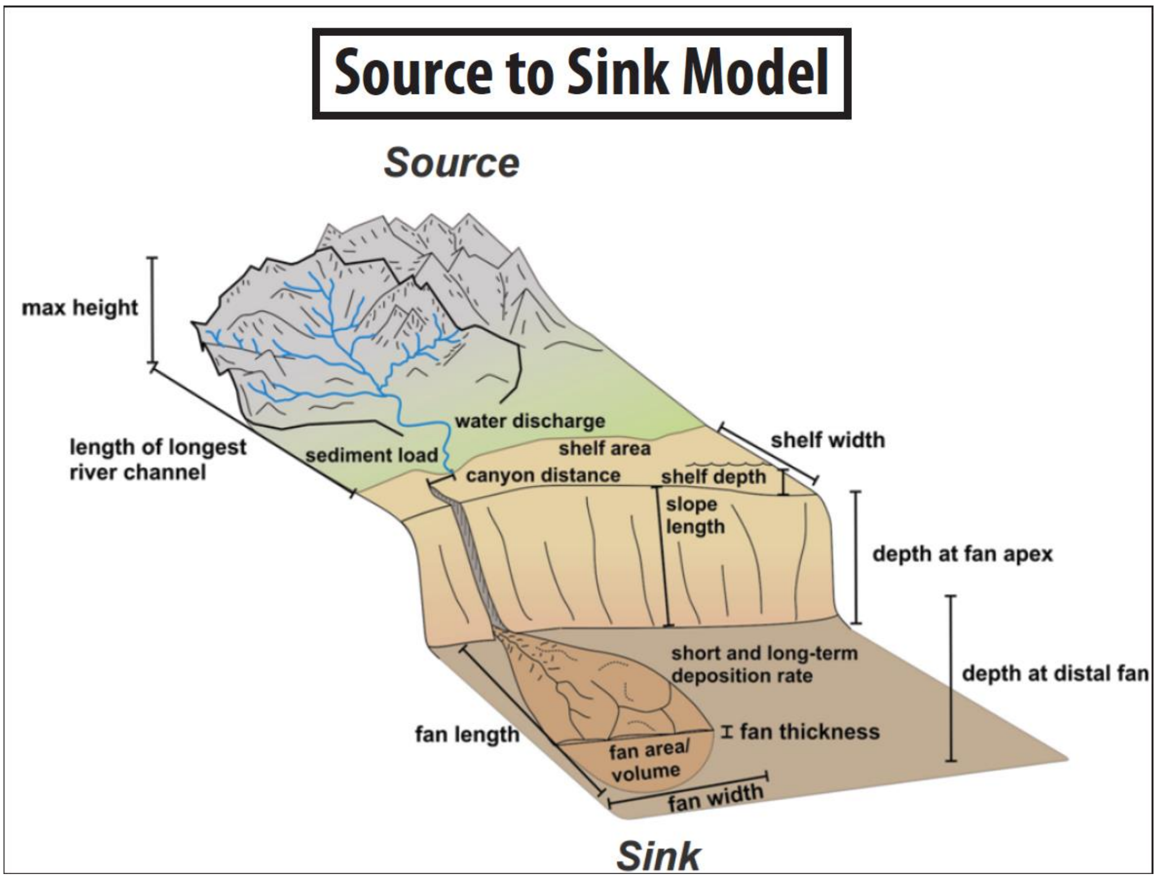


Figure 3: Source to Sink model highlighting importance of slope canyons in deepwater sediment delivery (modified from Sømme et al., 2009).

This study is designed to better understand the depositional and delivery systems of the coastal plain to shelf of the Upper Wilcox clastic wedge in the Houston Embayment. By identifying paleogeographic features on the shelf in the embayment area, researchers can use S2S principles to better constrain their predictions of reservoirs hundreds of miles downdip. The dataset contains >63,000 well locations and logs, of which 312 have been selected for this project and combines with outcrop data to characterize the Upper Wilcox over the Houston Embayment of the Gulf Coast (Figure 4). Paleogeographic, sand thickness, log signature, and transgressive/regressive shoreline maps were generated from the dataset over an area of 30,000 km2 to identify 5 transgressive-regressive (T-R) sequences within the Upper Wilcox clastic wedge. Initial findings indicate that the lower sequences of the Upper Wilcox may have taken advantage of the under-filled Yoakum Canyon to deliver sediment into the deepwater Gulf of Mexico.

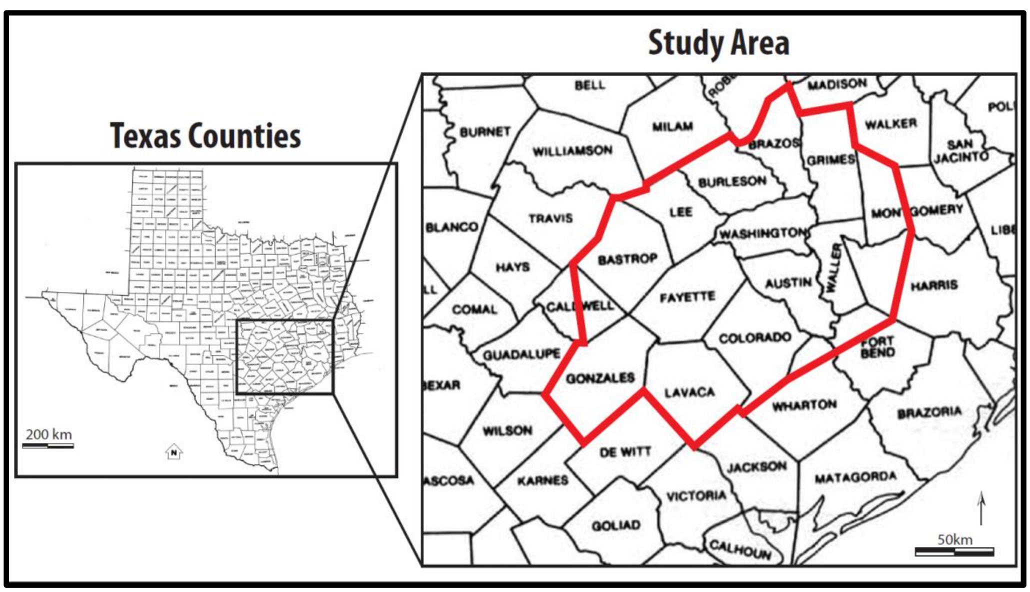


Figure 4: Outline of the study area. Image courtesy of the BEG.

The main objectives and new contributions of this work are:

1. Establish a high-frequency sequence framework for the Upper Wilcox in the study area that reflects the fundamental regressive-transgressive transits of the Wilcox delivery system on the Texas shelf
2. Present new paleogeographic maps, paying attention to river, wave and tide process components, based on the regressive and transgressive episodes of shelf building
3. Calculate river discharge for the Wilcox delivery system in the study area
4. Examine the effect/impact of the relict Yoakum Canyon on the early Upper Wilcox sequences

Background/ Geologic Setting

The Wilcox Group along the northwest margin of the Gulf of Mexico is composed of three or four (Crabaugh in 2001 advocated four) large third-order clastic wedges , spanning 11 million years (Jeff P Crabaugh & Elsik, 2014; Fisher & McGowen, 1967). After the opening of the Gulf of Mexico, Wilcox sediments were the first major terriginous deliveries to the basin (Figure 1) (Winker, 1982). The Wilcox sediments built across the carbonate Tuscaloosa shelf margin and slope system to establish more basinward shelf edge positions (Fisher & McGowen, 1967; Galloway et al., 2000; McDonnell, Loucks, & Galloway, 2008). There were three main depocenters along the Gulf Coast for Wilcox sediment, from the northeast to the southwest they are the Mississippi, Houston, and Rio Grande Embayments (Galloway, 1989). Each clastic wedge was derived in large part from one of three major sediment discharge 'pulses', mainly from the rapidly uplifting Laramide Orogeny at this time that ran from the middle of the United States into northern Mexico and from the subsequent erosion of these mountain's eastern flanks (Figure 5) (Crabaugh, 2001; Dickinson et al., 1986; Galloway, Whiteaker, & Ganey-Curry, 2011; Winker, 1982).

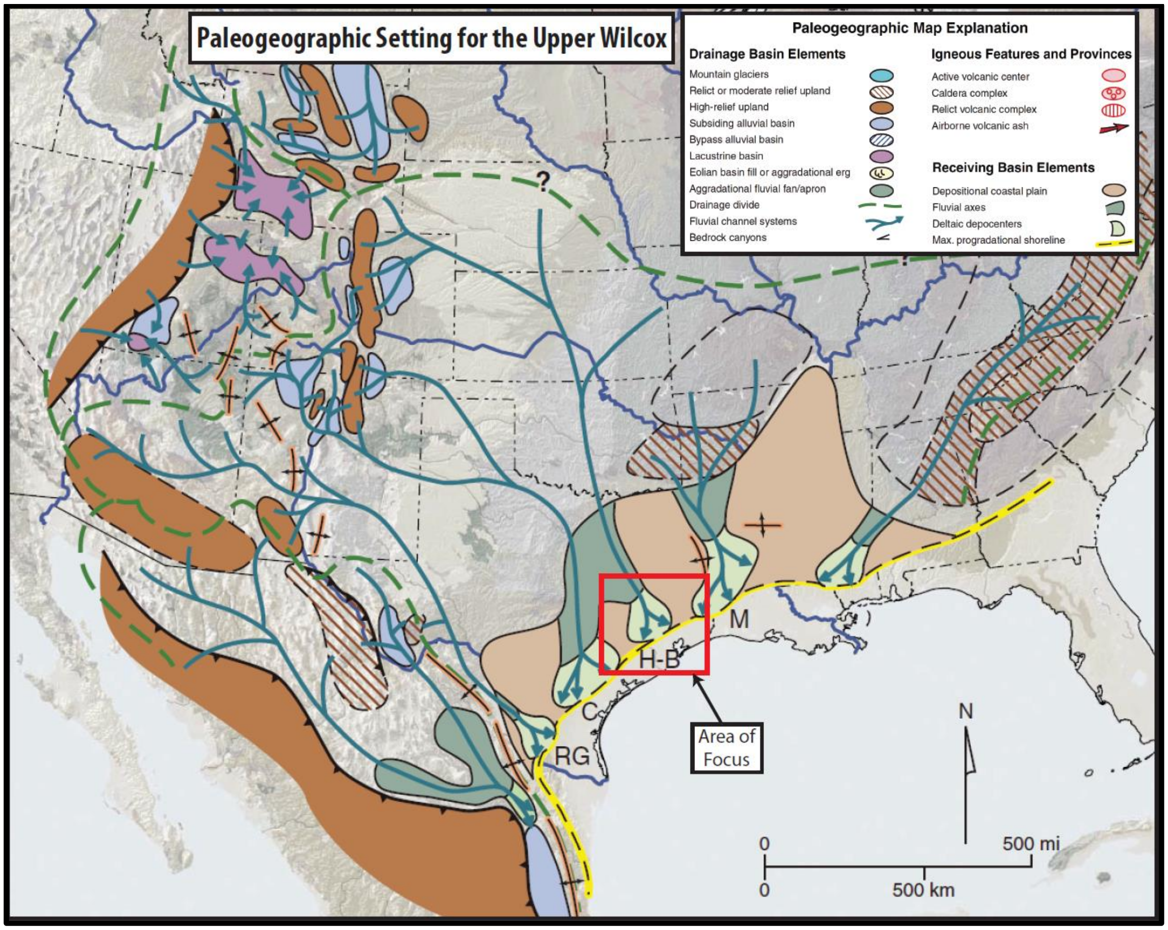


Figure 5: Paleogeography and tectonic setting during the late-Paleocene early-Eocene during the deposition of the Upper Wilcox clastic wedge. The study area, the Houston Embayment, is highlighted in red. The main depocenter for the Upper Wilcox was the Rio Grande Embayment to the south of the studied area, labeled RG (modified from Galloway et al., 2011).

Wilcox rocks in outcrop are present across thousands of kilometers of the Gulf Coast, from Alabama where they were first named in 1906 (Adkins & Plummer, 1932) in the northeast, down into Mexico in the southwest (Hargis, 1984; Xue & Galloway, 1995). The Wilcox deposits outcrop in a narrow band, 15-30 km wide, subparallel to parallel and between 150-330 km inland from the modern coastline (Bebout et al., 1979). The Wilcox clastic wedges represent three genetic third-order genetic sequences (lower, middle and upper) as was defined by Galloway (1989) (Figure 1).

Beginning at the base, the lowermost delineation begins with the Midway Shale, a regional marine transgressive shale that occurred 61 Ma in the late Paleogene that caps tens up to one hundred meters of undifferentiated terrestrial muds that had prograded over the inherited carbonate shelf edge (Figure 1) Galloway et al., 2000; Hargis, 1962; Winker, 1982). The Lower Wilcox, consisting of thousands of feet of sandstone, lies conformably on the Midway shales and built out into the northern Gulf of Mexico (Figure 6). These sands, as noted above, were largely derived from the newly active Laramide Orogeny uplifting in the middle of the North American continent (Figure 5) (Coney, 1976; Dickinson et al., 1986; Hargis, 1996; McDonnell et al., 2008; Smith, Carroll, & Singer, 2008). Most of the Lower Wilcox sediments were deposited within and by-passed through the Houston Embayment, of central and northern Texas, resulting locally in 160 km of deltaic progradation and massive growth faulting of the underlying muds of the Midway group (Figure 6) (Jones, 1964; Rains et al., 2007).. Within the Lower Wilcox in the Houston Embayment, Fisher and McGowen (1967) mapped seven distinct depositional systems: The Mt. Pleasant fluvial, Rockdale delta (underlying the present study deposits), Pendleton lagoon-bay, San Marcos strand-plain-bay, Cortulla barrier-bar, Indio bay-lagoon, and South Texas shelf systems (Fisher & McGowen, 1967; Xue & Galloway, 1995).

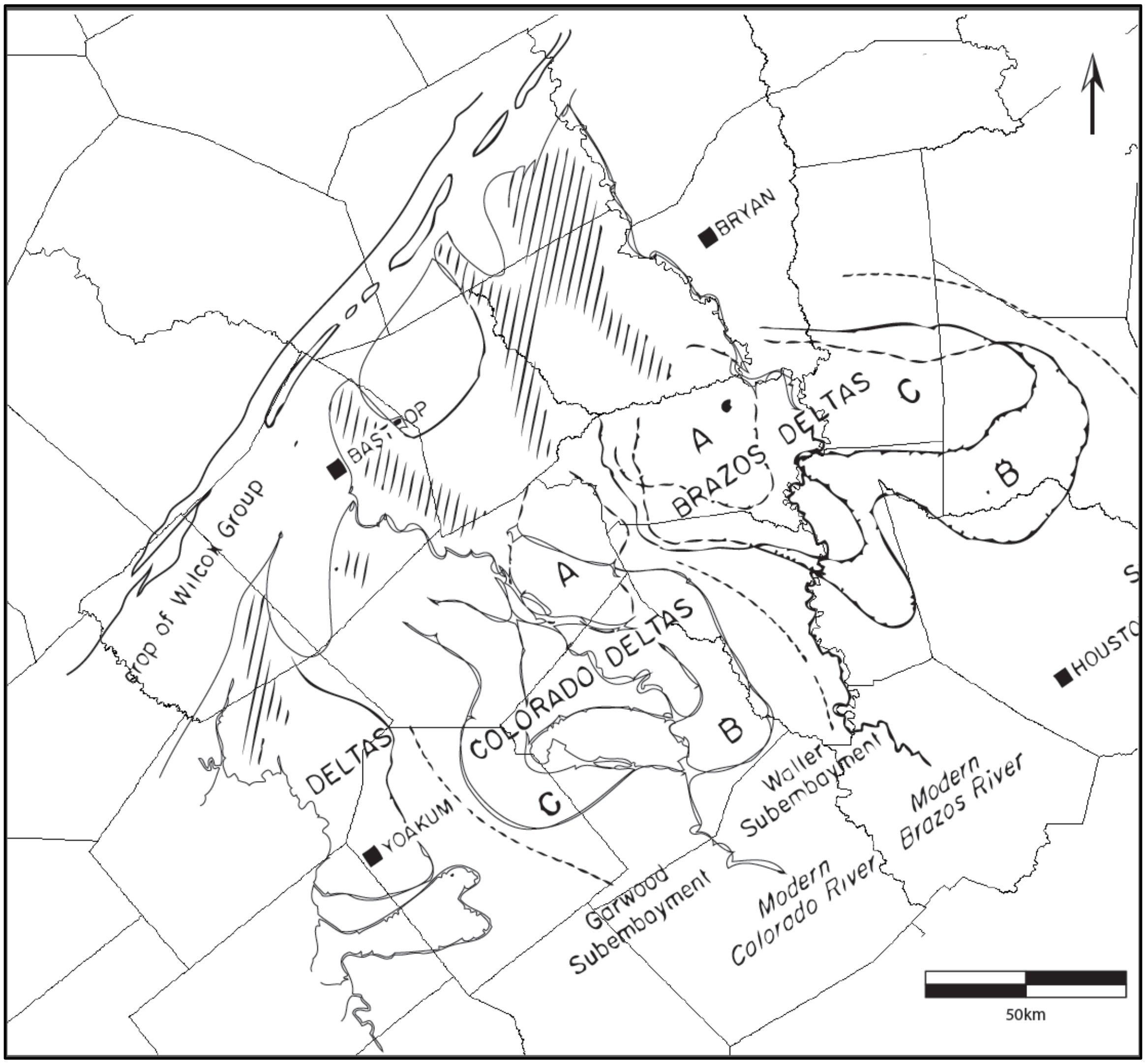


Figure 6: Colorado and Brazos deltas that partially compose the greater Lower Wilcox Rockdale delta system. These firm substrates provided stable bases for the Upper Wilcox to prograde across (modified from Fisher & McGowen, 1967).

The Big Shale (56.5 Ma) can be identified in outcrop from Louisiana to South Texas and demarks the division between the deposits of the Lower Wilcox below and the Middle Wilcox above (Hargis, 1996; Xue & Galloway, 1995). Unlike the Lower Wilcox, the Middle Wilcox is dominated by muddier aggradational units and sandstone only comprises 20-40% of the lithology. The Middle Wilcox on the whole is considered a more transgressive unit, possibly due to a temporary reduction in Laramide sediment delivery and/or because of associated eustatic changes (Xue & Galloway, 1995). The Yoakum Canyon (Figure 7) was incised into sediments in the southwest of the Houston Embayment at the end of the Middle Wilcox from 53-54.5Ma (Bebout et al., 1979; Dingus, 1990; McDonnell et al., 2008; Zarra, 2007). The incision is still a matter of debate, but the Yoakum Canyon, Lavaca Canyon and other slope conduits acted as funnels to bypass sediment from the shelf into potentially lucrative deepwater reservoirs (Cornish, 2013; W. E. Galloway, Dingus, & Paige, 1991; McDonnell et al., 2008). Both the Middle Wilcox and the Yoakum Canyon fill is capped by the Yoakum Shale (54.5Ma), another regional marker and maximum flooding surface (W. E. Galloway et al., 1991; Hargis, 1984, 1996; Miller, 1989; Xue & Galloway, 1995).

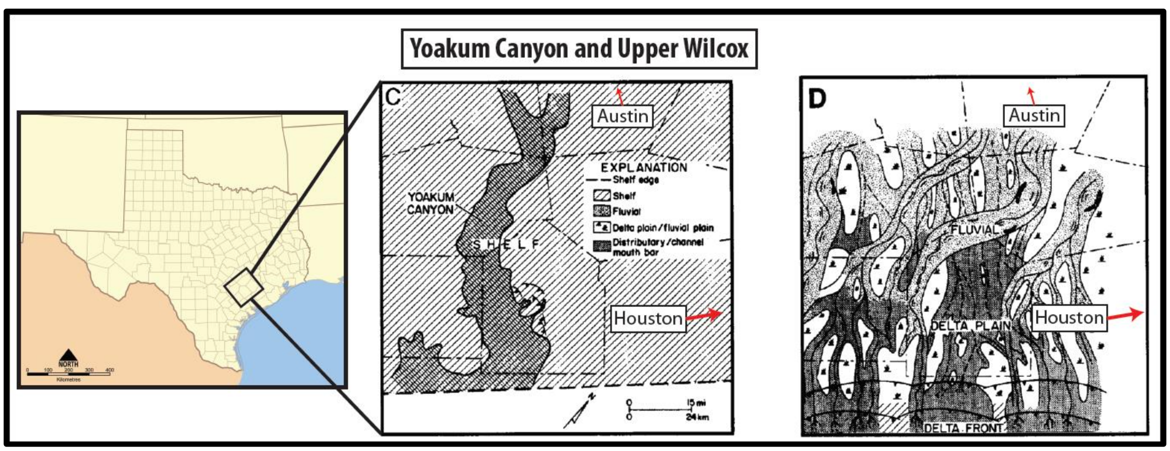


Figure 7: Outline and overlying environments of the Yoakum Canyon. **C:** An outline of the Canyon in the top of the Middle Wilcox clastic wedge. **D:** A third order interpretation of the environments that overrode the Yoakum Canyon (Modified from Dingus & Galloway, 1990).

The main depocenter for the Upper Wilcox was the Rio Grande Embayment along the South Texas coastline (Figure 5) (Edwards, 1980; Galloway et al., 2011; Hamlin, 1983; Miller, 1989). The largest feature of the Upper Wilcox is the South Texas Upper Rosita Delta system and the updip fluvial Carrizo sandstone (Edwards, 1980; Galloway et al., 2011; Hamlin, 1983; Miller, 1989). The Upper Wilcox represents the second major basinward shift of depositional facies in the Gulf of Mexico and if often attributed to a late surge in tectonism and associated erosion from the Laramide Uplift (Crabaugh & Elsik, 2014; Davis et al., 2009; Galloway et al., 2011; Miller, 1989; Winker, 1982). The Upper Wilcox is capped by the Reklaw (49Ma) maximum flooding surface which is present from Mexico to Louisiana (Galloway et al., 2000; Hargis, 1996).

PREVIOUS WORK ON UPPER WILCOX STRATIGRAPHY

A large Texas-wide study correlating the Wilcox units in the subsurface with well logs (Bebout et al., 1979) was designed to target geothermal resources, and established a region-wide stratigraphic framework.

Work on the Upper Wilcox has mostly been focused on the deposits in the Rio Grande depocenter rather than on Houston embayment as it played host to the majority of Upper Wilcox sediments (Bebout et al., 1979; Breyer, Bellamy, & Phornprapha, 2001; Edwards, 1980; Fiduk, Anderson, & Rowan, 2004; Hamlin, 1983; Hargis, 1996). Gulf of Mexico-wide paleogeographic maps have been published (Galloway et al., 2000, 2011; Galloway, 1989a; McDonnell et al., 2008) some of which include short descriptions (i.e. fluvial dominated plain, or coastal plain) for the entire Upper Wilcox in this study area. Figure 8 shows paleogeography of the entire Upper Wilcox clastic wedge (McDonnell et al., 2008).

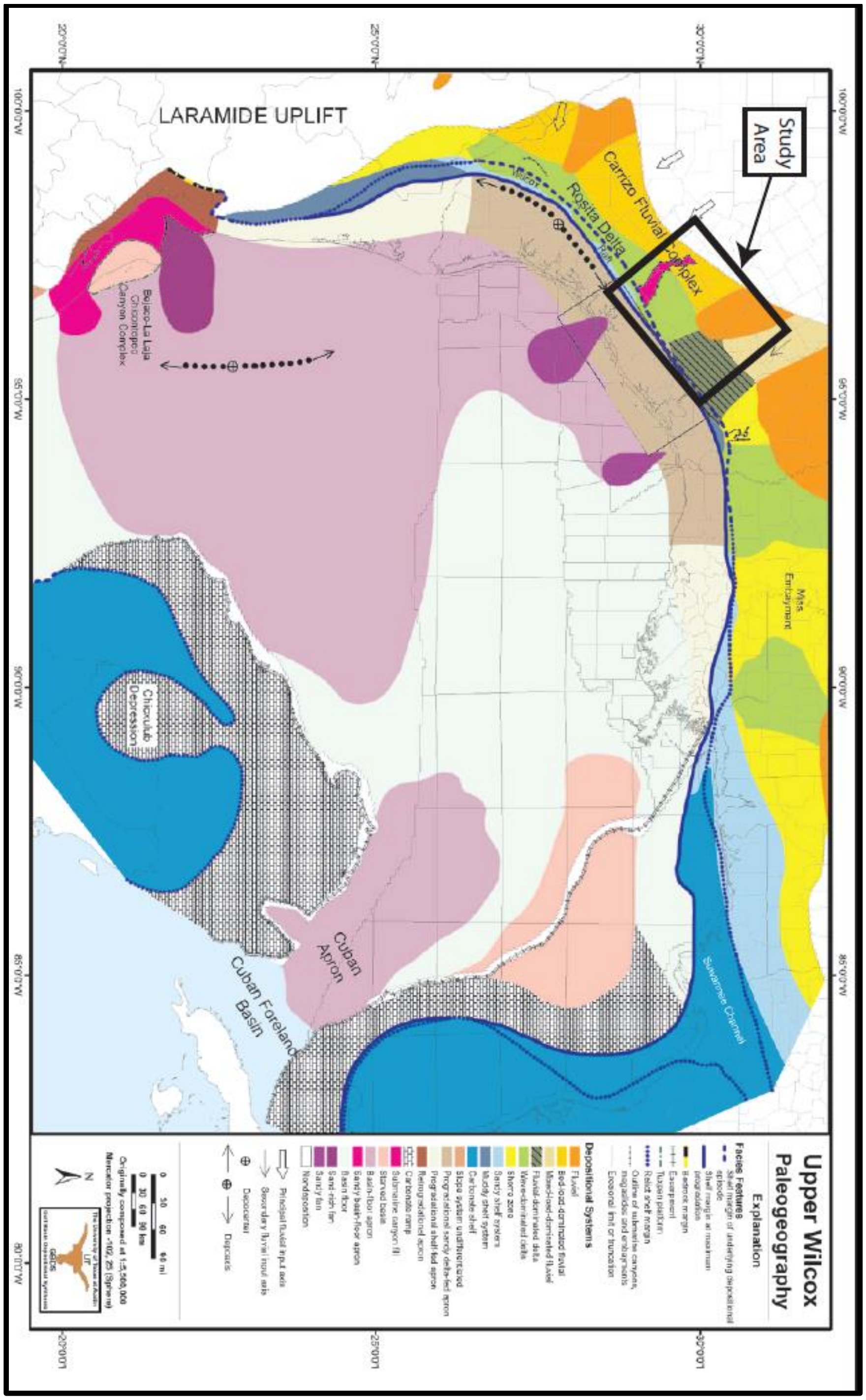


Figure 8: A map of the depositional environments in the Houston Embayment during Upper Wilcox time. This map represents around 5Ma, this study generates paleogeography for each 4th order sequence within the Upper Wilcox clastic wedge (modified from McDonnell et al., 2008).

There are two studies that have been conducted solely on the Upper Wilcox in the Houston Embayment: Ayers and Lewis (1985) and Miller (1989). Ayers and Lewis's (1985) work was located in the region landward from my study area and focused on the Carrizo fluvial sandstones and their associated economic coal deposits. The work defines channel courses via sandstone isopach maps. Miller's (1989) analyzed the Upper Wilcox formation across Texas as a genetic stratigraphic unit. Within the Houston Embayment, Miller (1989) labeled two deltas of the Upper Wilcox clastic wedge: the Columbus delta that was fed by the Jewett fluvial system, and the Jasper delta fed by an unnamed system delivered from Southern Louisiana (Figure 9) (Miller, 1989).

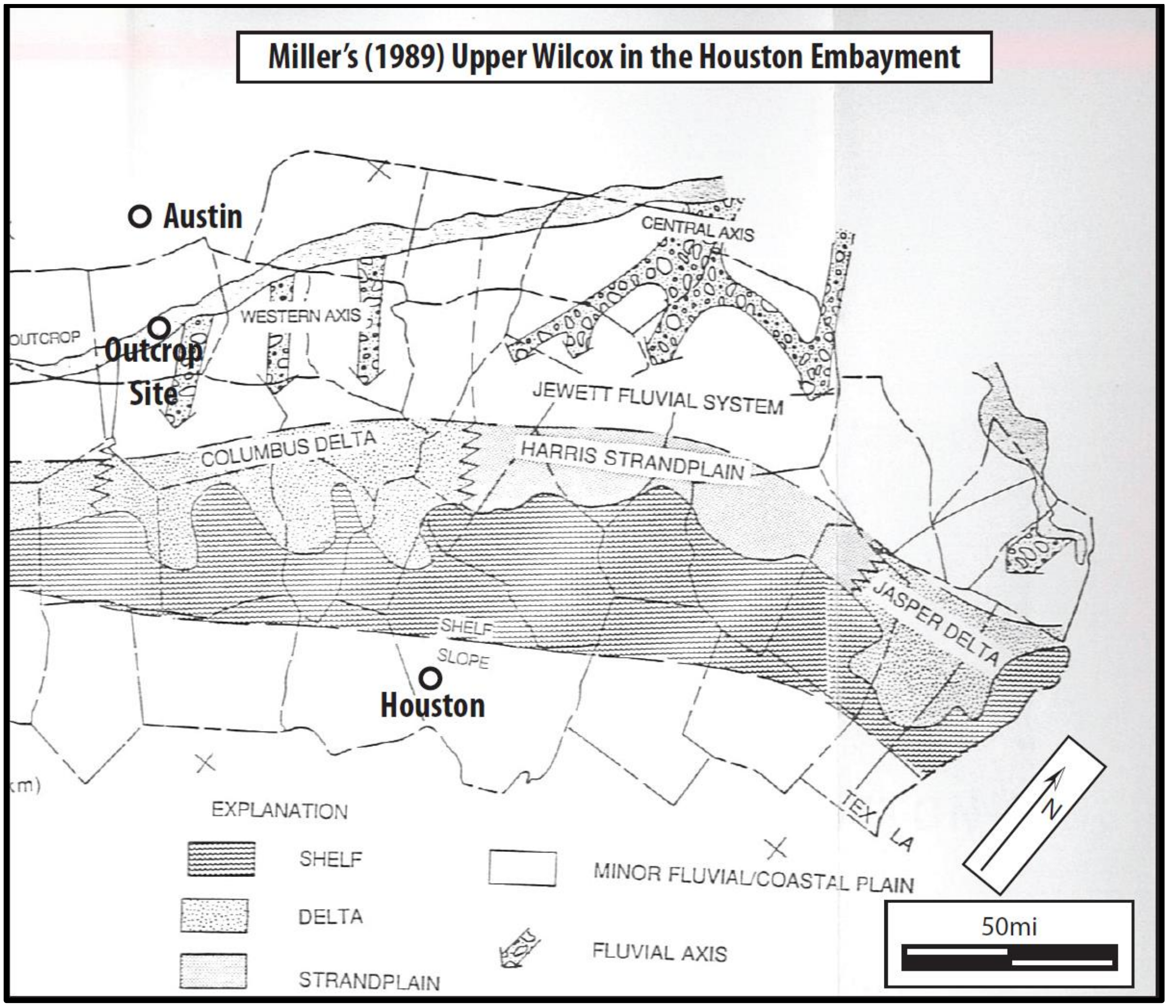


Figure 9: Depositional environments of the Upper Wilcox clastic wedge. The Columbus delta, Jasper delta, Jewett fluvial system, the "western axis", and the unnamed system entering from the north are all present in this study's sequences, but are broken out of the third order wedge (modified from Miller, 1989).

The fluvial systems named "Western" and "Jewett" presented in Figure 9 in Miller (1989), Galloway's "Houston-Brazos" in Figure 5 (2011), and "Primary Axis" in Ayers and Lewis (1985) (not pictured), are the same system designed to represent drainage to the Houston Embayment for all of the Upper Wilcox clastic wedge (Ayers & Lewis, 1985; Galloway et al., 2011; Miller, 1989). The present study divides the Upper

Wilcox clastic wedge into 5 sequences within which there are fluvial axes that together constitute the larger previously described axes.

Methods and Data

SUBSURFACE DATASET

310 logs were selected by their location, quality, and penetration of the interval of interest. Many of the selected logs are available in the form of *.TIFF image files. To begin well log correlation across the selected area TIFF files were combined with neighboring wells with digitized GR and SP logs. To better manipulate the available data across the field, selected logs were converted to *.las files. The resulting digital well spacing ranged from between 20 km at the most to 0.2 km, with an average around 4 km.

Condensed sections that were generated by transgressive events and starvation of terriginous materials were picked in well logs to establish a basic lithologic framework (Galloway & Hobday, 1996; James & Dalrymple, 2010). Previous studies (Bebout et al., 1979; Galloway et al., 2000; Miller, 1989; Xue & Galloway, 1995) provided a comprehensive list of wells logs and maps with the Reklaw and Big Shales clearly identified. Although previous works did not employ the current Unique Well ID format used in this study, common wells in the previous study and in the present dataset were identified to follow the Reklaw and Big Shale picks from the previous studies. Bebout's cross sections were used as a baseline framework to establish the depths of the bounding surfaces of the Upper Wilcox clastic wedge. To describe stratigraphy in the study area, seven dip-oriented cross sections were generated with between 15 and 20 km of spacing between them following Bebout's framework (Figure 10) with *.Tiff files. Each cross section has between five and ten wells and begins where Wilcox outcrops in the northwest and ends where the section thickens and drops below well control in the southeast typically within massive growth faulting (Edwards, 1981). Two more regional strike oriented cross sections were also generated to verify correlations between dip cross sections. All of the wells and sections were correlated and flattened on the top of the Upper Wilcox at the Reklaw Shale, seen as a regionally distinctive spike in GR and drop in resistivity (Figure 11).

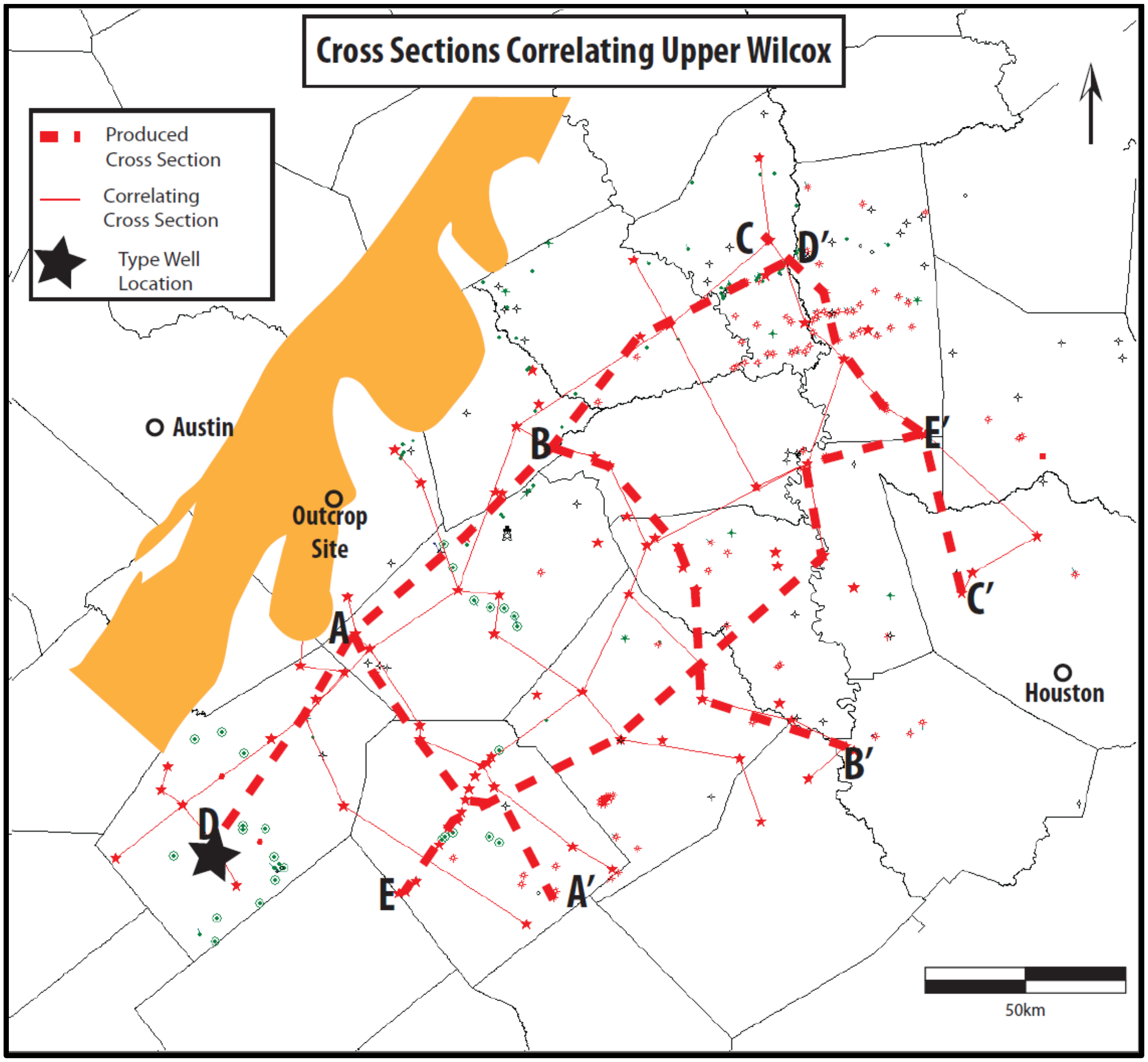


Figure 10: Locations of 300 digital wells in this dataset along with the seven dip-oriented and 2 strike oriented cross sections used to build a stratigraphic framework across the field (solid thin red lines). Cross Sections with interpreted depositional environments, section 3.1, shown in thick dashed red. Wilcox outcrop is shown in orange. The black starred well is used as a model well below.

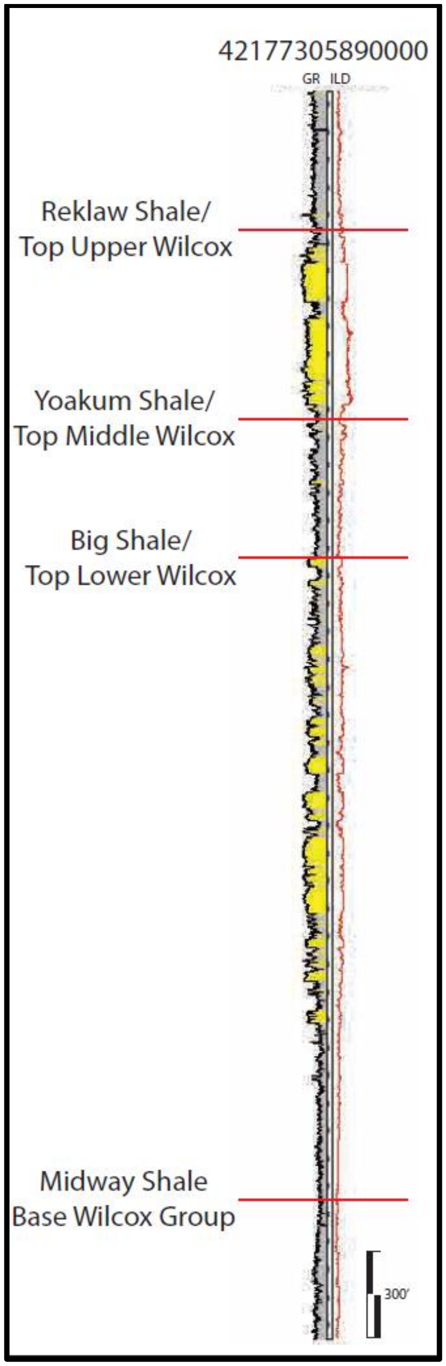


Figure 11: Type well Gamma-Ray and Resistivity response to the three clastic wedges of the Wilcox. Wedge defining shales are in red.

After the upper and lower bounds were delineated, higher frequency (forth order) flooding surfaces were established throughout the Houston Embayment and assigned names Upper_1 through Upper_4. These four flooding surfaces subdivided the Upper Wilcox into five R-T (regressive-transgressive) cycles, Sequences 1 through 5 (Figure 12). In total, 1,100 TIFF file well logs, and 189 las file well logs were used for correlation in this study.

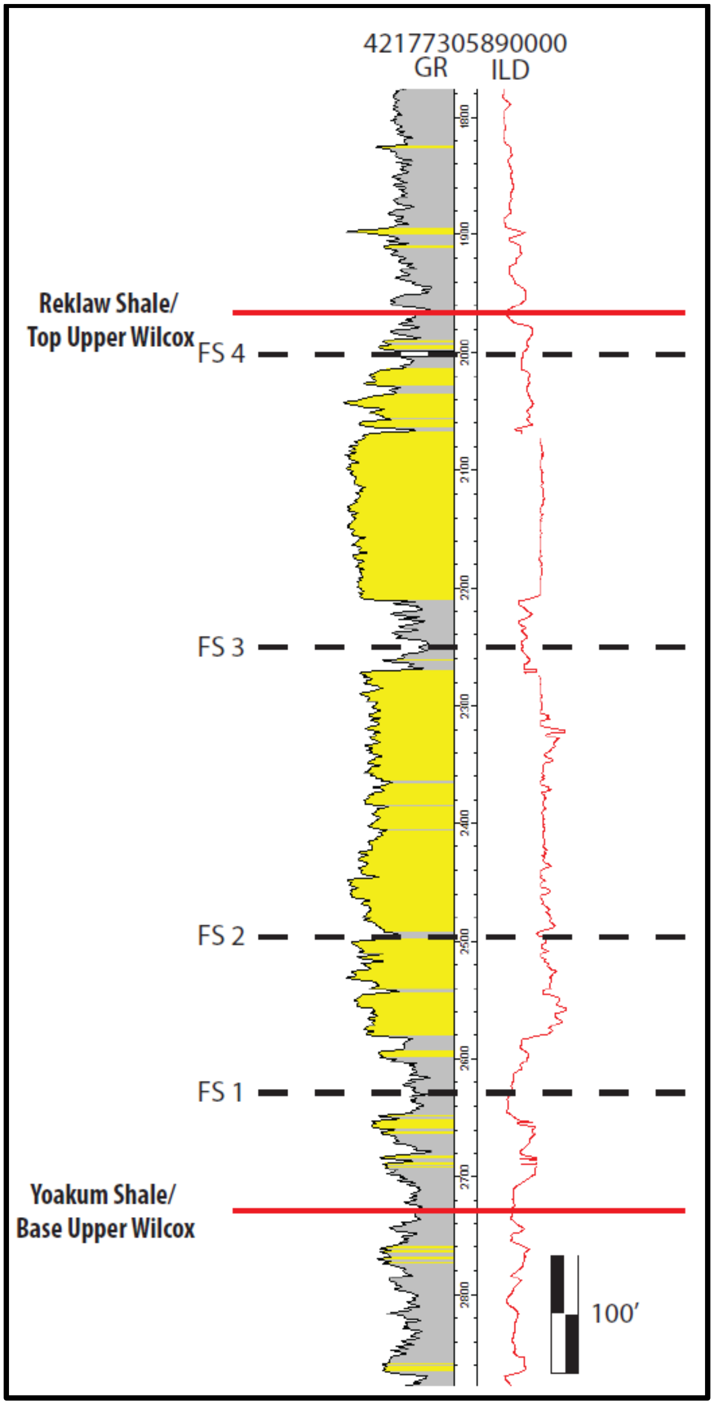


Figure 12: Type log for the Upper Wilcox clastic wedge with both Gamma-Ray and Resistivity responses. Five 4th order regressive-transgressive sequences were delineated with the fine units represented by the dotted lines. Higher order regional MFS surfaces are in red.

Picking the Depositional Sequences of the Upper Wilcox

Each sequence of the Upper Wilcox is defined by a flooding surface above and below. Identifying regionally pervasive intervals of high GR values corresponding to finer material was the first step (Galloway, 1989a). There were many such surfaces in the Houston Embayment, but only four that were traceable across the entire dataset between the Reklaw and the Yoakum shales. To pick each sequence a flooding surface was identified in the basinward region of the field area where there was a very clear signal and was then traced updip into the more landward deposits where the signal was more challenging to pick. In some of the most updip regions, the picks fell on finer intervals that may not have been transgressed over, but represented a backing up of systems resulting in brackish environments that deposited more finer material than the regressive half cycles above and below (see FS 2 in Figure 12). Sequence 1 is capped by Flooding Surface 1 (FS 1 in figure 12) which is identifiable by both a GR spike and by low resistivity. It is the smallest sequence of the Upper Wilcox with an average thickness of 34 m (110 ft). The regressive portion of Sequence 1 is often muddy, as it follows the basin-wide Yoakum transgression event. The second flooding interval is most easily recognized by higher GR values but not always with a corresponding dip in resistivity (Figure 12). Sequence 2 has an average thickness of 52m (170 ft) and generally has a slight upward coarsening in the regressive half of the sequence (Figure 12). The third flooding surface is characterized by both a spike in GR and dip in resistivity values and is the thickest sequence with an average thickness of 84 m (275 feet). The regressive half of Sequence 3 shows an upward coarsening pattern, and in the landward regions of the field area the transgressive half shows upward fining patterns. The fourth flooding surface defining the top of Sequence 4 usually appears as a sharp spike in resistivity following the pervasive sands of Sequence 4 but does not commonly show a corresponding dip in resistivity values (Figure 12). Sequence 4 has an average thickness of 69 m (225 ft) and shows a very strong preservation of sediment during the transgressive half of the sequence. Sequence 5 is the thinnest sequence of the Upper Wilcox clastic wedge as it represents the beginning of the basin-wide Reklaw transgression. It has an average thickness of 36 m (120 ft) and almost entirely shows a long upward fining sequence that eventually turns into the Reklaw Shale (Figure 12).

Cross Sections

Each of the depositional dip and strike-oriented cross sections (Figure 10) had wells picked for their ability to highlight depositional environments within the embayment. AA' was created to show the strongly progradational shoreline through the sequences over the Yoakum Canyon region. BB' and CC' were chosen to show how shorelines prograded less in relation to their proximity to the Yoakum Canyon region. DD' and EE' show the differences of depositional environments in strike across the 200 km of the Houston Embayment. The .las files were interpreted by their log signature patterns (Figure 13) to elucidate their environments of deposition as was detailed in Galloway and Hobday (1983). When an environment was interpreted, a corresponding color fill was assigned to that section of the well within the cross section. The regions between the wells were interpreted based on depositional environments relationships and from stratigraphic principles (such as fluvial deposits, coals where basinward of the shoreline). The environments interpreted in the cross sections were used to build regional summary paleogeographic maps for any given forth-order sequence.

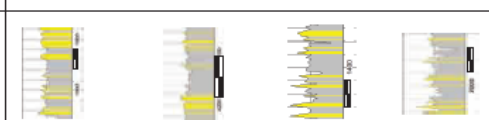
Log Facies	Sand Thickness	Facies Thickness	Log Pattern 50′ ~15m	Signature/ Description
Delta/ Shoreface	30-150′ 10-45m	50-250′ 15-75m		Single or multiple upward coarsening bodies with gradual base and relatively sharp top or small upward fining
Prodelta/ Shelf	3-25′ 1-7m	3-350′ 1-105m		Isolated upward coarsening bodies in mud matrix down-dip (basinward) from the delta/shoreface log patterns
Lake	6-20′ 2-6m	30-150′ 10-45m		Upward coarsening with a relatively sharp top, less sand content than marine delta/ shoreface facies defined above, contained between terrestrial patterns
Delta Plain/ Marsh	15-40′ 5- 13m	50-200′ 15- 60m		Isolated upward coarsening thin sands in muddy matrix updip (landward) from delta/ shoreface facies
Fluvial Axis	20-150′ 6-45m	30-200′ 10-60m		Single or multiple blocky sands with sharp bases and either sharp or upward fining top
Estuary/ Transgressive	25-150′ 7- 45m	50-350′ 15-105m		Mixed blocky and upward fining sands, thicker than upward fining fluvial pattern
Floodplain/ Overbank	2-10′ 0.6-3m	20-40′ 6-12m		Isolated sharp based sands and thin (meters) upward coarsening often within overall muddy deposits updip from delta/shoreface log facies
Coastal Plain	5-30′ 1.5-10m	50-250′ 15-75m		Frequent isolated sharp based sands in a muddy matrix, sand bodies are thinner than fluvial axis. This facies is landward and relatively close to delta/shoreface log facies

Figure 13: Description and interpretation of log facies used to determine and map depositional environments.

Mapping

Well log correlations were made with Petra software and the sandstone thickness maps for each depositional sequence were also generated in Petra. Each forth order sequence is defined by the flooding surfaces above and below that have been picked as Upper_1 through Upper_4. The sequences (specific zones in Petra) were then subjected to reservoir property calculations, specifically around determining the footage of well that had an API value less than 75 (assumed to be sandstone). With these gross sandstone values stored, contoured grids were generated in the mapping module to display the sand within the selected sequence. This contoured map was then plotted across the study area (Houston Embayment) resulting in the figures displayed in the Results section of this thesis.

Log signature maps were also generated in Petra. For each sequence the log pattern between picked flooding surfaces reflects the depositional environment for the selected sequence. The software then lays all of the available log signatures within a sequence on a map of the study area to better visualize the log pattern distribution. The log signature maps in this thesis do not display all of the available logs. Instead, selected logs were chosen to draw attention to typical well log trends as well as to reduce over-crowding in the map.

To generate shoreline maps, well log signatures in a given sequence were assigned marine or non-marine interpretations based on their patterns (Figure 13). Where the logs transitioned from non-marine to marine was assigned as a shoreline across the embayment (Figures 14 and 15). The regressive shorelines mark the most basinward that non-marine depositional environments made it in a given sequence. Above the regressive shoreline in the log, the flooding surface or section of finer material marks the transgression that ends the transgressive half of the underlying sequence (Figure 16). The most landward shoreline corresponds to the transgressive shoreline and therefore the distance between the regressive and transgressive shorelines provide the distance transgressed. Similarly, the distance from the transgressive shoreline to the overlying regressive shoreline gives the transit distance of maximum regression.

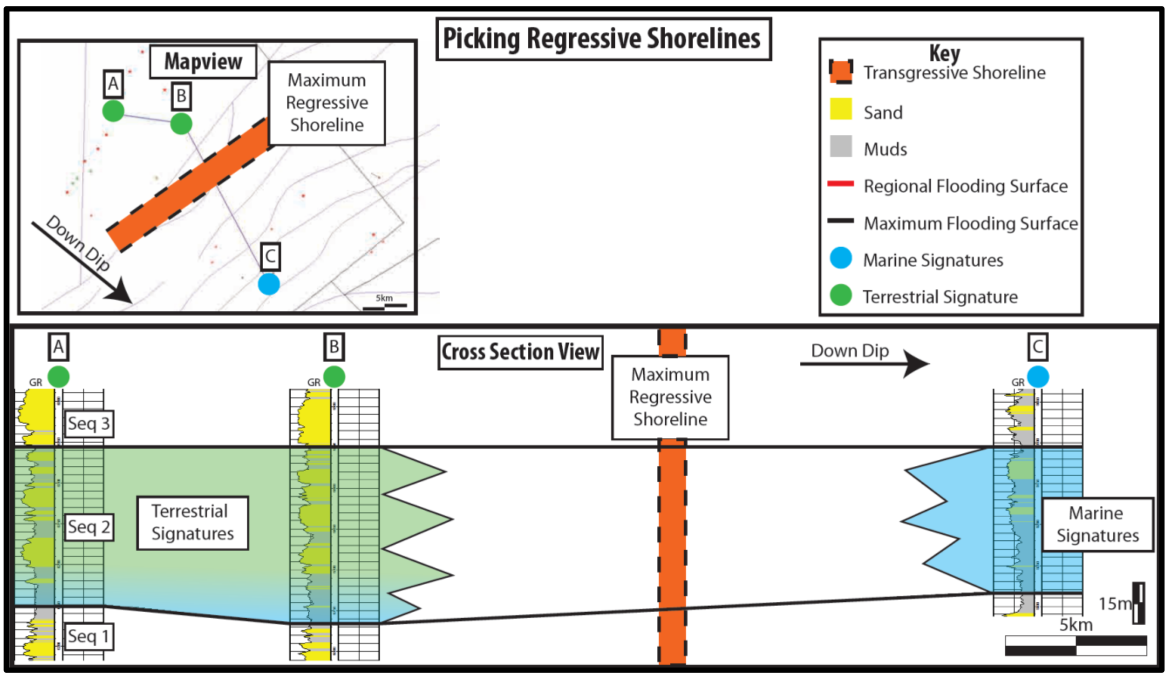


Figure 14: The process for picking regressive shorelines. The two wells on the left of the image show terrestrial signatures within the selected sequence, the well on the right shows non-terrestrial signatures. Therefore, the regressive shoreline falls between the two wells and a line can be delineated on a map, as is seen in the top right. Note: the interpreted depositional environment only represents a point in time for the sequence. The bases of the left hand wells have shallow marine signatures, but for the sequence as a whole, they are mapped in respect to their larger fluvial signatures.

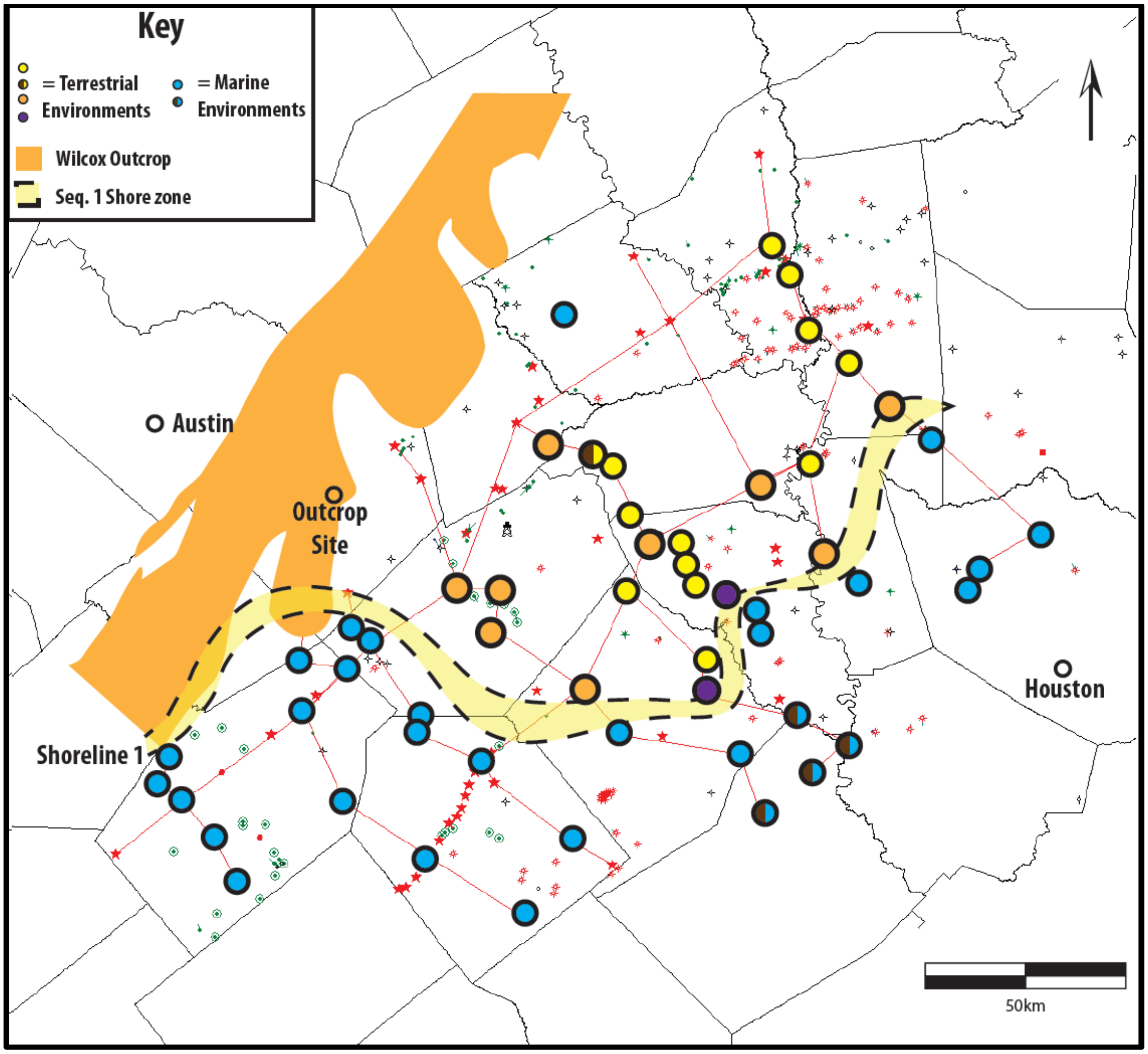


Figure 15: Picking a regressive shoreline in mapview. The process shown in Figure 14 is repeated across the entire embayment, and then the lines dividing non-terrestrial and terrestrial signatures are connected- resulting in a line showing the most landward limit of terrestrial facies. Colors assigned to wells based on their depositional environment allow for easy visualization of the shoreline.

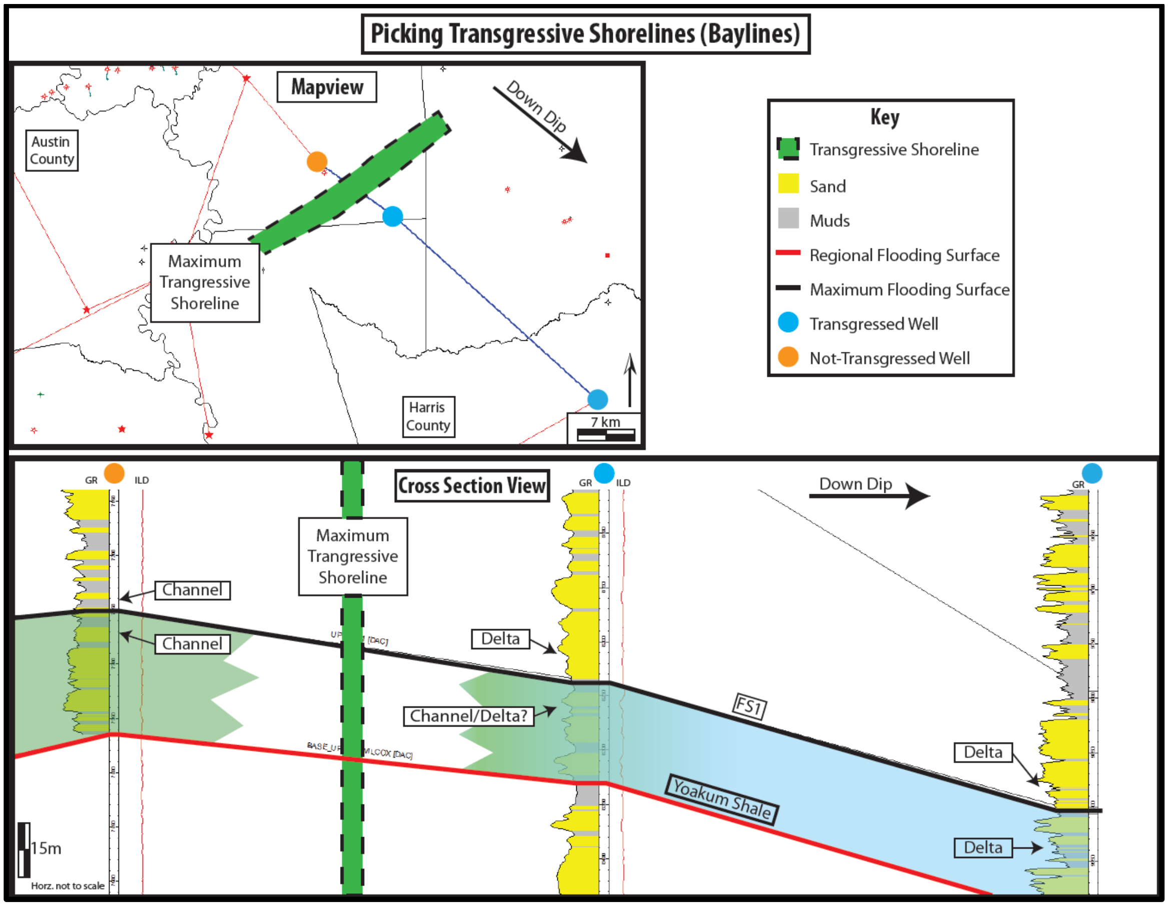


Figure 16: The process of picking transgressive shorelines (Baylines). When there are channels above and below a sequence division, the transgression did not reach that well. When there are channel or deltaic signatures below the dividing fines and a delta signature above, the transgression reached at least this well's location between sequences.

Paleogeographic maps combine the data provided by all of the previous mapping methods. The sand thickness maps allow for representation of sand trends within the sequences. Then log signature maps can be used to interpret what kinds of sand bodies the trends identified in the sand thickness maps represent. Figure 13 allows for a general categorization of log patterns and the resulting interpretation of depositional environment (Galloway & Hobday, 1983). Generating the regressive shoreline maps and establishing their positions, allows for the analysis of the length of the shelf that each sequences progrades across. By analyzing each sequence with respect to its shoreline location and the resulting division between marine and non-marine environments, the rest of the sequence can more easily be partitioned into depositional environments. The sand thickness and log signature maps are then combined to delineate general environments of deposition that are transposed on a map of the embayment.

OUTCROP DATASET

The following features and parameters were measured, documented and analyzed from available outcrops of the Upper Wilcox in the study area in Texas; bed or set thickness, grain size, paleocurrent directions, trace fossils, sedimentary structures, and erosional surfaces. Where bar-like architectures were seen, the heights of such bars were measured. Outcrops were measured in the Lost Pines neighborhood of Bastrop County, TX (Figure 17) over an area of 1 km by 1 km. Previous workers have documented some of the outcrops and focus on paleontology or sedimentology of the deposits, and confirm that the outcrops in this study belong to the Upper Wilcox (Breyer et al., 2001; Fisher & McGowen, 1967; Hargis, 1962, 1984; Sams, 1990). However, many of the exposures have only recently become accessible after the Bastrop County Complex fire of 2011 that razed homes and brush around prime exposures.

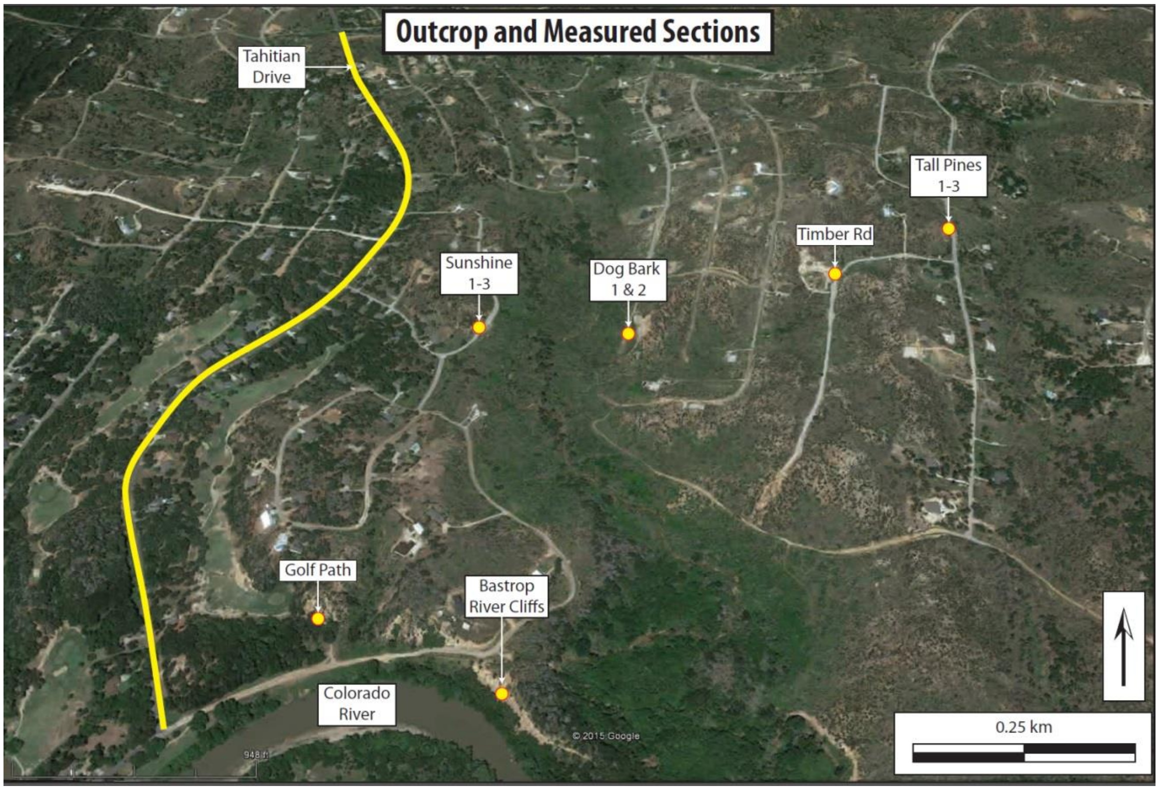


Figure 17: Location of outcrops in the Tall Pines neighborhood of Bastrop County. Tahitian Dr. is highlighted in yellow.

Measured outcrops in this study lie just southwest of Bastrop between 1 and 2.2 miles from TX-71 E/TX-95 S down Tahitian Drive (Figure 17). Dog Bark outcrop (two long sections) is located 1.4 miles down from Tahitian drive on Manawianui Drive. Sunshine outcrop (three short sections) lies 0.3 mi down Mamalu Drive from Tahitian Drive. Tall Pines outcrop (three short sections) is 1.3 miles from Tahitian Drive on Tall Forest Drive. Exact coordinates for the outcrop locations can be found in the appendix.

PALEOFLOW CALCULATIONS

The data collected in the field from the Bastrop outcrops can be used as a foundation to perform approximate paleoflow calculations. These results are then used to help constrain the channel dimensions of the fluvial system of the Upper Wilcox in the Bastrop area. Figure 18 shows where each equation fits into a model landscape as well as average values for the measured outcrops.

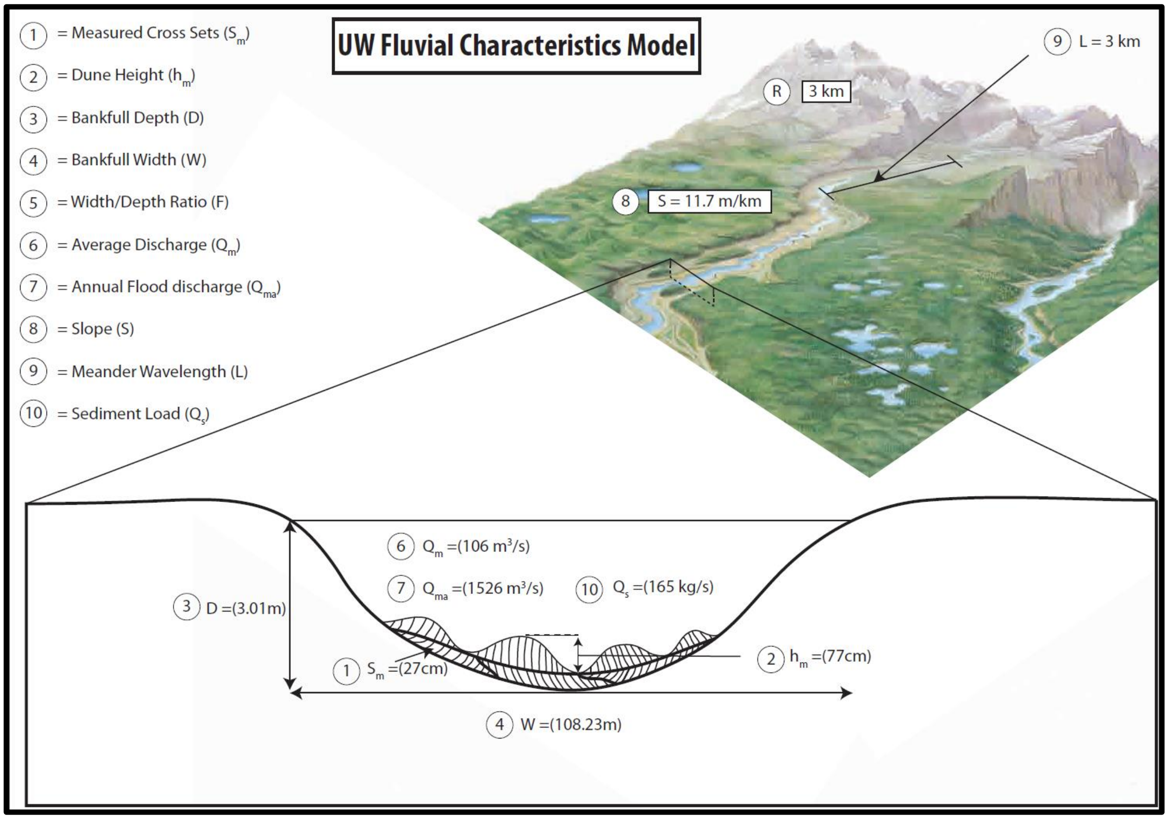


Figure 18: Fluvial characteristics model. This figure shows where each value calculated in the methods section comes from or is attributed to. The exact values presented come from the calculations from the outcrop results section of this thesis and represent the measured Upper Wilcox outcrops.

Individual sets of cross strata were recorded in the field from near vertical outcrop sections. Related sets of cross-strata were identified by grouped sets having the same paleocurrent direction as well as by being contained between higher order bounding surfaces (Paola & Borgman, 1991). After averaging cross-strata set thicknesses (Sm) in distinct packages, values can be entered into an equation designed to calculate mean bedform height (hm) (Leclair & Bridge, 2001):

Eq. 1 $$hm \approx \frac{5.3S_m}{2.8} = 2.9Sm$$

There is a 0.25 factor of error built into Eq. 1 resulting from potential error in the field measurements due to overestimation of cross set thickness (Holbrook, 2001; Leclair & Bridge, 2001). This Sm value ideally represents conditions during peak flow (bankfull), instead this value may in fact represent dune height during waning flow conditions when bedforms are more likely to be preserved resulting in overestimation of dune height (Holbrook & Wanas, 2014). However, Lunt et al. (2013) studied this dilemma in Saskatchewan, Canada and came to the conclusion that preserved cross sets can be used a reasonably accurate input for dune height equations.

After establishing Sm and the ensuing calculated hm, other characteristics of the paleoflow can be determined. The first step is to calculate bankfull channel paleodepth (D) using the following equation which is applicable when 0.1<D<100m and is also subject to a potential of up to 0.25 factor of error (Allen, 1982; Bridge & Tye, 2000):

Eq. 2 $$D = 11.6hm^{0.84}$$

With average paleoflow depth established, Ethridge and Schumm (1977) present a distillation of equations spanning 60 years to calculate other defining characteristics for paleoflows beginning with Leeder (1973) equation to calculate bankfull width (W) of depositing channels from dune height (channels need to have a sinuosity of >1.7, the average sinuosity of the measured outcrops was 3.64):

Eq. 3 $W = 6.8D^{1.54}$

With bankfull width and bankfull depth established, the conventional next step in the modern is to sample silt/clay ratios (Sc and Sb) from the stream bed with a 200 mesh sleeve to assess the carrying capacity and make further calculations (Schumm, 1960). This method is unavailable to workers studying preserved deposits in the field (thin section analysis would be necessary to differentiate authentic vs digenetic clays) (Ethridge & Schumm, 1977). Instead, a set of relationships and equations to navigate this issue and replace modern measurements with F (W/D) was proposed. This relationship, F, is the key to calculating all of the ensuing paleoflow characteristics (Ethridge & Schumm, 1977; Schumm, 1972):

Eq. 4 $F = W/D$

After arriving at F for a system, a number of conditions of the paleoflow can be established with just W, D, and F. P, a measure of a river's sinuosity is given by Equation 5 (Ethridge & Schumm, 1977; Stanley A Schumm, 1963). Mean annual discharge of the system (Qm) is calculated through Eq. 6 (Ethridge & Schumm, 1977; Stanley A Schumm, 1968). Mean annual flood (Qma) is given by Eq. 7 (Ethridge & Schumm, 1977; S. A. Schumm, 1972). Channel slope (S) is given by Eq. 8 (Cotter, 1971; Ethridge & Schumm, 1977; S. A. Schumm, 1972; Stanley A Schumm, 1968). Meander wavelength (L) is given by Eq. 9 (Ethridge & Schumm, 1977; S. A. Schumm, 1972).

Eq. 5 $P = 3.5*(F)^{0.27}$

Eq. 6 $$Qm = \frac{W^{2.43}}{18F^{1.13}}$$

Eq. 7 $$Qma = 16\frac{W^{1.56}}{F^{0.66}}$$

Eq. 8 $$S = 30\frac{F^{0.95}}{W^{0.96}}$$

Eq. 9 $$L = 18(F^{0.53} * W^{0.69})$$

At this stage there are many aspects of the paleoflow that can be calculated. However, to make these data useful for resource exploration purposes, delivered sediment load (Qs) is the most important variable as the river derived sediments make up traditional clastic reservoirs. In the same way that the silt/clay ratio is not directly measureable in the preserved strata, the sediment load also cannot be measured directly. Instead, Syvitski et al. (2003) has developed a series of proxies based on a global database of 340 modern rivers and associated regression models to indirectly estimate sediment load. Ideally, basin drainage area, relief of the basin, and temperature would provide basic controls for paleoflow sediment load equations. While this study does not work to constrain those exact values, this study does contain data that can be used as proxies for the missing variables.

Syvitski et al. (2003) models show that there is a strong correlation between fluvial discharge (Qm) and basin area (A), and that ensuing calculations can use Qm in the stead of A. Eq. 6 allows for the calculation of fluvial discharge, therefore Syvitski et al (2003) equations can be used on this dataset to determine sediment load of the depositing systems of the Upper Wilcox. The other variables needed are: temperature within the basin (T), relief from highest point in the basin to the point of measurement (R), and a series of regression coefficients calculated by climate zone provided in Table 6 of Syvitski et al. (2003). The climate of the basin feeding the Upper Wilcox in the Houston Embayment is defined as tropic to sub tropic (Galloway et al., 2011). Syvitski et al. (2003) models presume an average temperature of +25°C for tropic regions north of the equator, this value will be used for T in the ensuing calculations. Needed regression coefficients are provided in Syvkski's Table 6 corresponding to northern tropic climates for these calculations (Syvitski et al., 2003):

$\propto_6 = 2.0$

$\propto_7 = 0.45$

$\propto_8 = 0.57$

$k = -0.09$

With these calculated values established the last variable, relief, needs to be addressed. In Galloway's 2011 summary, the headwaters that feed the Houston Embayment during the early Eocene originate along the northern region of the highly active Laramide uplift which had as much as 15 km of movement at the time (Chapin & Cather, 1983; Coney, 1976; W. E. Galloway et al., 2011). Because erosion worked on the newly uplifted orogeny, 3 km will be an upper limit in the ensuing calculations which assumes that sediment eroded from these altitudes were delivered to the Houston Embayment during Upper Wilcox time. With all of the above variables and coefficients established, Syviski's equation (Eq. 10) is used to find the sediment load transported by the systems of the Upper Wilcox outcrops in the Bastrop region (Syvitski et al., 2003):

Eq. 10 $$\mathrm{Q}_s = \propto_6 Q^{\propto_7} R^{\propto_8} e^{k\mathrm{T}}$$

Results

CROSS SECTIONS

Cross sections within the Houston Embayment highlight the range of depositional environments present in individual sequences and their interrelations between sequences. The wells logs use both gamma-ray values and SP values as is explained in the methods section of this thesis (Section 2). Log signatures within each sequence were interpreted (Figure 13) to assign depositional environments that were overlaid on the cross sections. See Figure 13 for categorization of log patterns and the ensuing assignment of depositional environments. Xue and Galloway (1995) employed a similar system to assign depositional environments in the Middle Wilcox (also see Galloway and Hobday (1983). To see the well logs without the overlain depositional facies, refer to the unannotated cross sections in the appendix. The stacking patterns observed in the cross sections can be explained by depositional patterns of repeating transgressive/regressive cycles as is displayed in Figures 19 and 20. Fluvial and blocky sharp based estuary sands being overridden by marine deposits between time 2 and time 3 in the figures is a stacking pattern often observed in the Upper Wilcox dataset. Variations in transgressive distances seen in cross sections are explained in Figure 21. The key variables in transgressed distance are sediment input and shelf gradient. To see where the cross sections are located in the embayment with respect to the interpreted environments, see Figure 22.

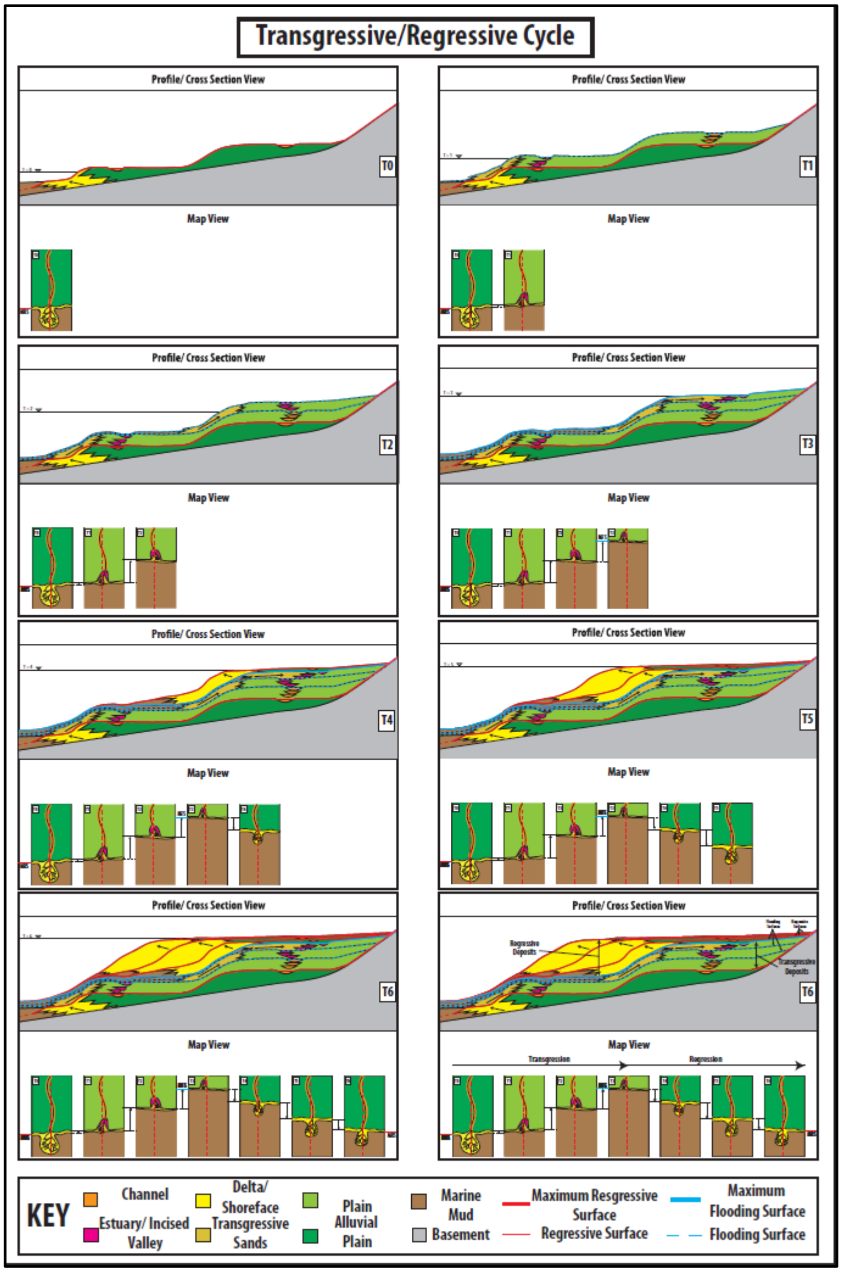


Figure 19: Model figure showing the building and stacking relationships of near-shore and shallow water environments through and regression and transgression. The final panel is reproduced larger in Figure 20.

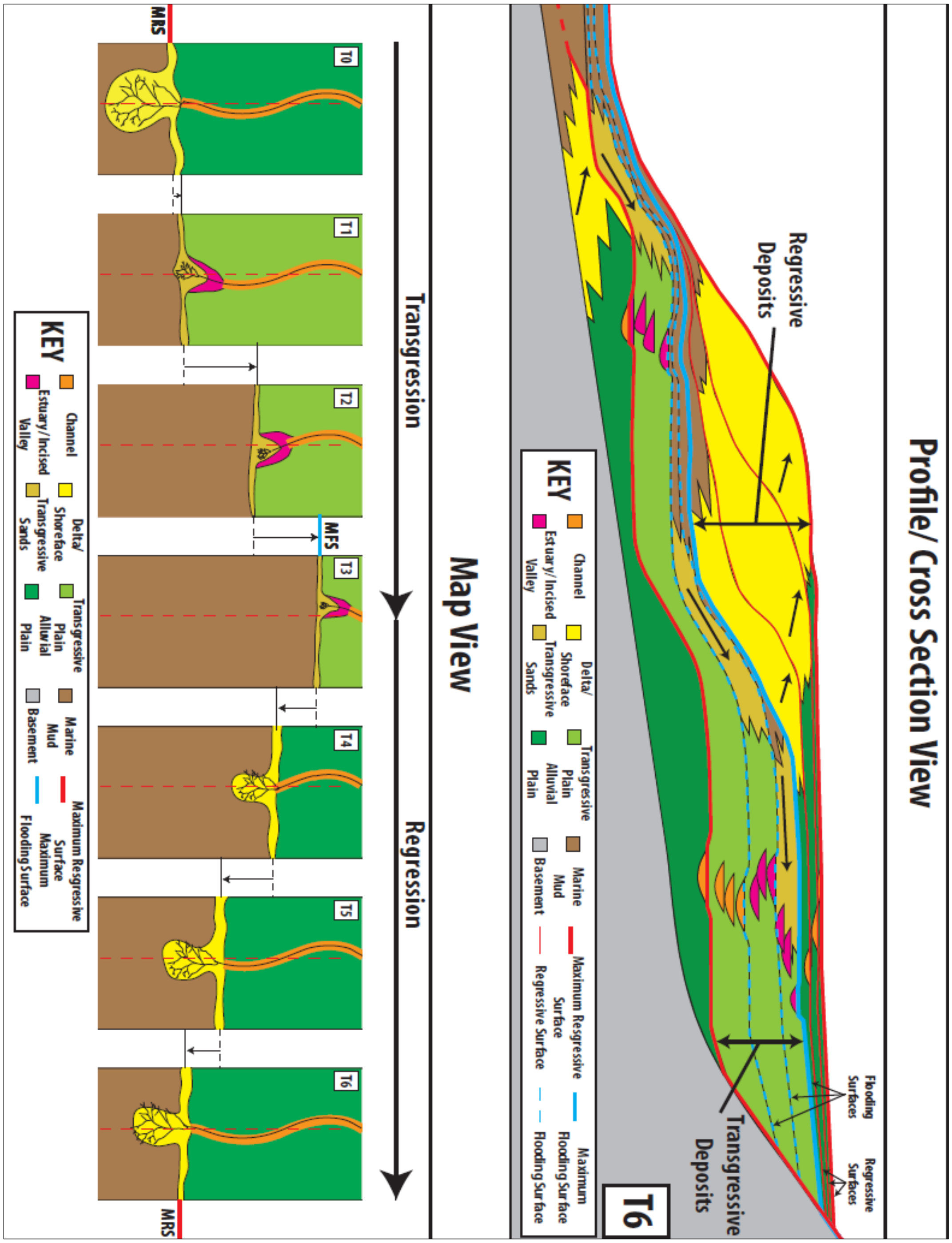


Figure 20: Expanded version with annotations of T6 from Figure 19. Channels being overridden by marine muds (orange or pink overlain by brown) are a unique feature in this model and are also preserved in deposits of the Upper Wilcox.

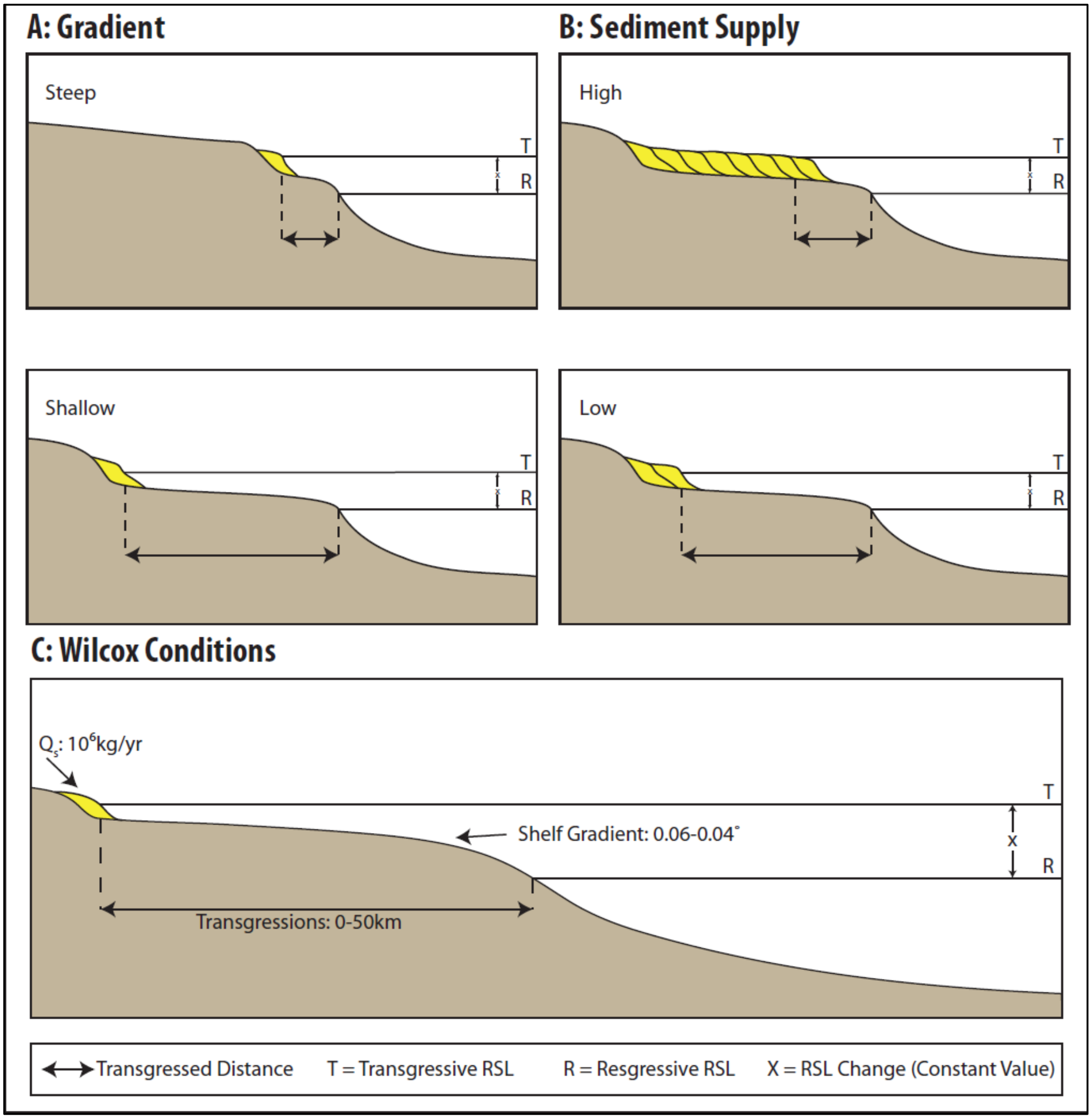


Figure 21: Model showing variations in transgressed distance. Two variables interact to change how far the bayline moves when eustacy is normalized; gradient and sediment supply. When the gradient is steep, the shoreline will not transgress as much as when the gradient is shallow. When sediment supply is high the shoreline will not transgress far in respect to when the sediment supply is low. These variables do not act independently.

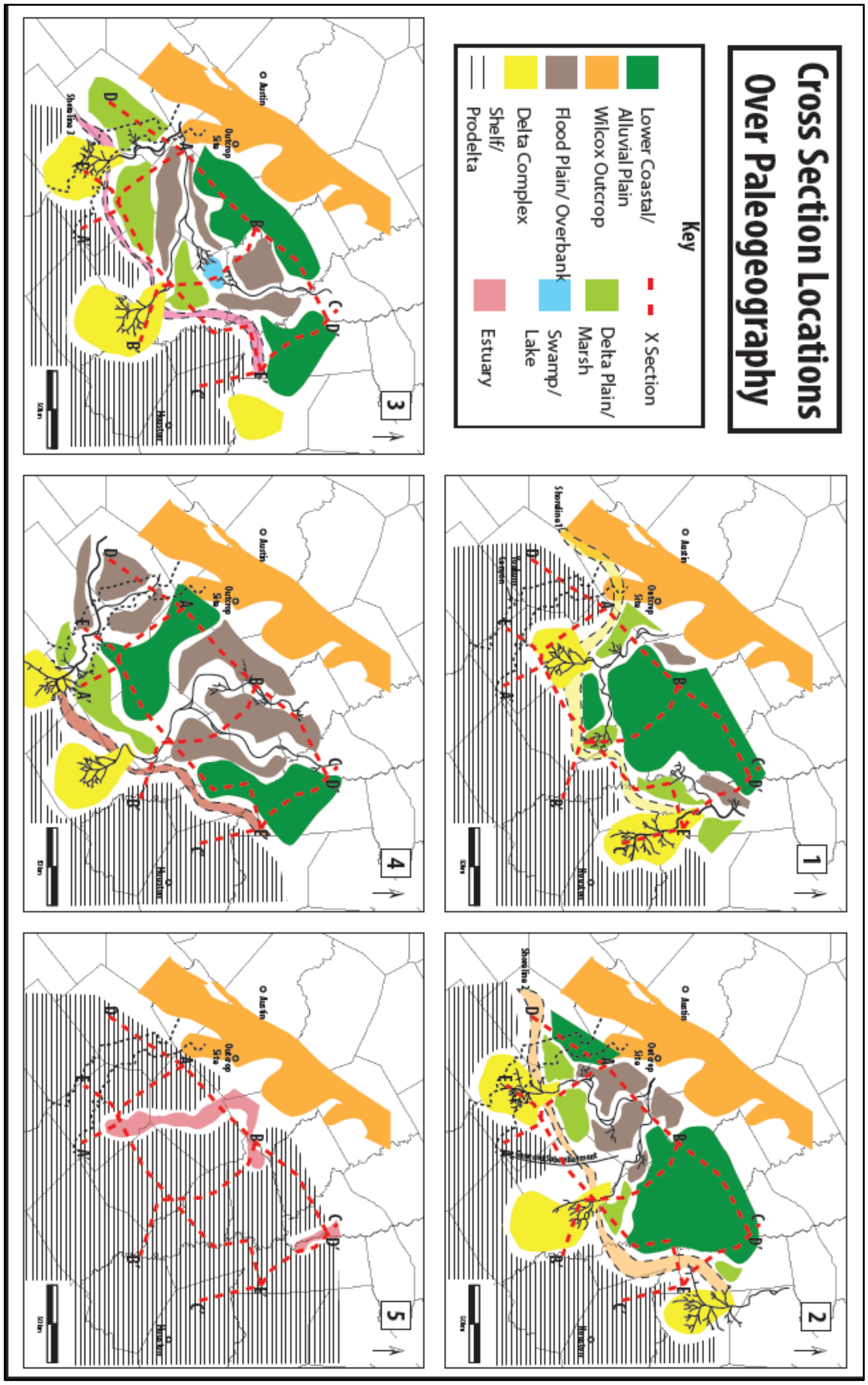


Figure 22: Depositional environments for each sequence with the location of the cross sections. Larger versions of these maps are available in the Maps section and appendix of this work.

Dip Sections

A-A'

A-A' (Fig.23), a depositional dip line, highlights the progradational nature of the Upper Wilcox clastic wedge over the Yoakum Canyon region. Although this cross section does not run through the axis of the canyon, well positioning was ideal along A-A' to highlight the regressive shoreline pattern through time. Cross section A-A' runs 77 km from the top of Fayette County to the base of Lavaca County and is 190m thick at well 1A thickening to 280m in well 6A (Figure 23). The progradation of the fluvial log facies (orange in Figure 23) through Sequences 1-3 shows rapid basinward progress with 30 km of progradation between Sequence 1 and 2 and then another 35 km in Sequence 3. Around 50% of the log facies in A-A' are made up of the fluvial log facies that dominates the preserved sediment in the region over the Yoakum Canyon (Figure 23). Sequence 5 shows a dominantly (80%) prodelta/mud log facies that is representative of the onset of the Basin-wide Reklaw Transgression that ends the Upper Wilcox clastic wedge (Sams, 1990).

The trend through cross section A-A', sections 1-4, is one of overall basinward shift in depositional facies. Fluvial channel log facies and delta/shoreface log facies prograde at least 77 km through the 5Ma (Crabaugh & Elsik, 2014) of the Upper Wilcox clastic wedge. A-A' shows the strongest progradation into the Houston Embayment, cross sections to the northeast B-B' and then C-C' display a transition from a progradational shoreline, to an aggradational/ somewhat retrogradational one.

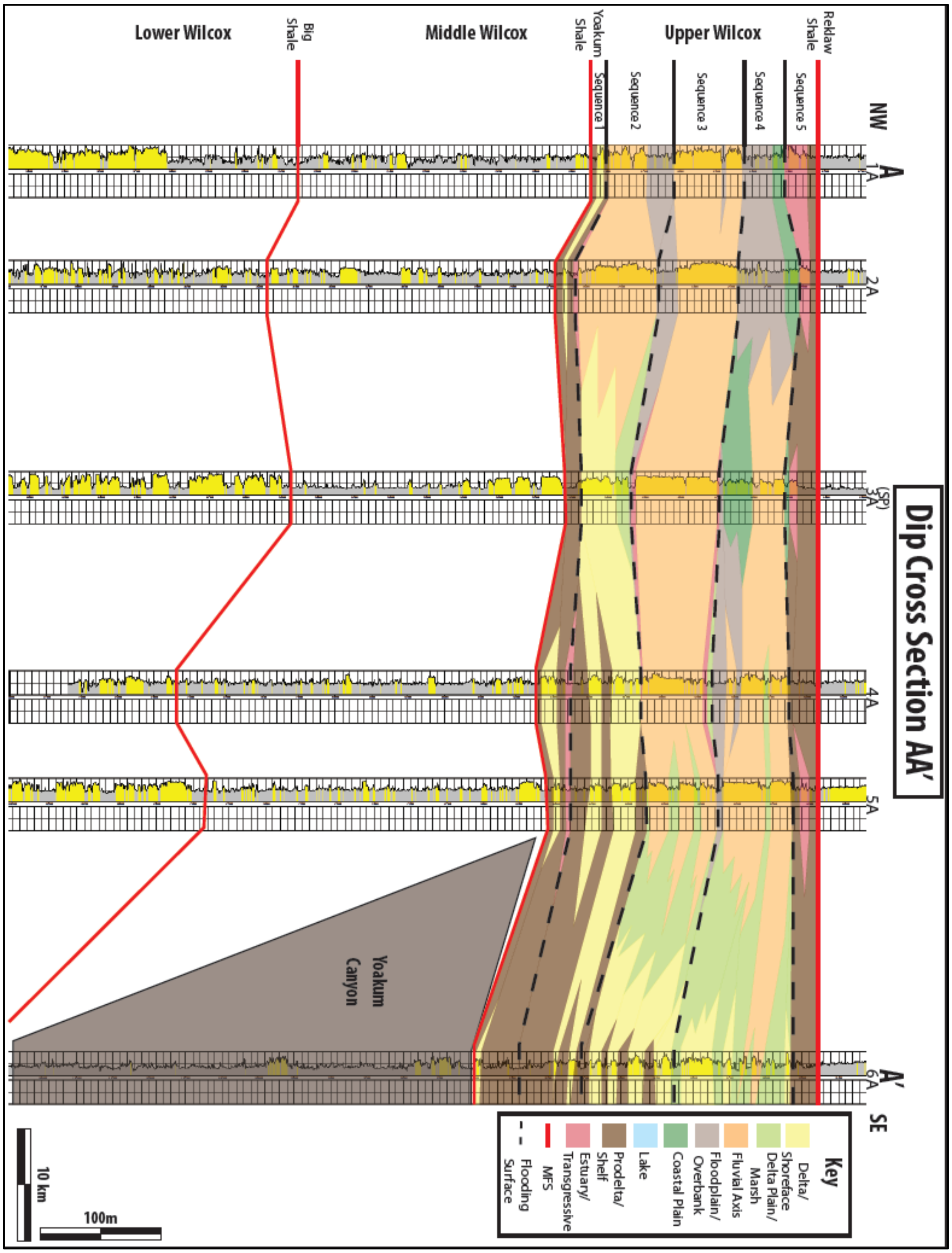


Figure 23: Dip cross section AA'. This cross section shows the strong progradational nature of the terrestrial system through time over the Yoakum Canyon region.

B-B'

Thick upward coarsening deltas are present in the upper half of Sequence 2 in well 6B. The 30m and 10m thick sandstones in the upper half of the where sandstone preservation is typically reserved for more landward regions deserves questioning. One explanation is that the delta system formed to the southeast for most of the section (as is seen in Figure 29.A), and only in the latter half of the sequence did the trunk channel avulse to deposit the full load more to the northeast where B-B' documents it. To have this supply scenario be a plausible explanation, the transgression would have to have not traveled very far landward between Sequences 2 and 3 to allow such sediment to be deposited so far basinward in the transgressive half of a sequence (see figure high supply and steep gradient in Figure 21). This stunted bayline (transgressive shoreline) pinned at the same point as its regressive counterpart is exactly what is observed over Colorado County updip of well 6B in Figure 29.D, confirming this explanation. The transgression failed to inundate any of land around 6B (Figure 29.D), possibly due to high supply (Figure 21), between Sequences 2 and 3, allowing for the deposition of deltas in the upper half of Sequence 2.

Wells 3B and 4B are host to a unique set of 5-10m coarsening up log patterns that are updip of the coastline (Figure 24). The coarsening up log signatures of finer material are interpreted to have been deposited in swamp/lake depositional environments (see appendix Figure 1 for lake cross section). The Sequence 3 coastal plain region of the Upper Wilcox clastic wedge lies between the Colorado and Brazos deltas (Figure 6) of the underlying Lower Wilcox platform (Figure 6). The inter-deltaic space allows for the overriding weight of the Upper Wilcox deposits to compact the muddy underlying substrate and generate local topographic lows for the interpreted lakes to form in.

The cross section B-B’ shows the aggradational to slightly progradational nature of the depositional facies in the middle of the Houston Embayment during Upper Wilcox times. The progradation of 10 km between sequences 2 and 3 is far less than that of 70 km observed in A-A’ and is considerably more than the aggradational to retrogradational facies shift of section C-C’. The lake deposits interpreted in B-B’ is a unique set of well signatures that is not observed anywhere else in the Houston Embayment’s Upper Wilcox clastic wedge.

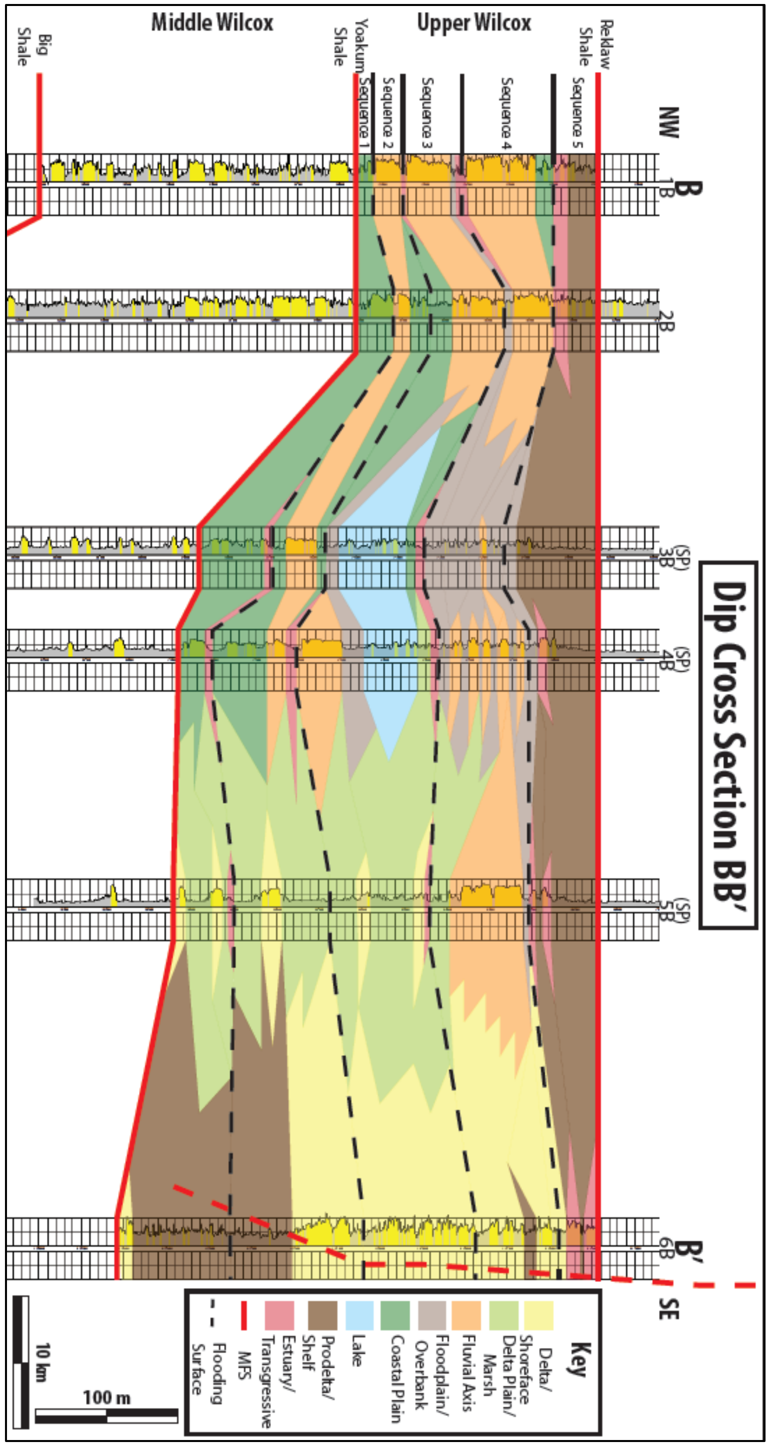


Figure 24: Dip cross section BB'. This cross section shows the weak progradational to aggradational nature of the terrestrial system through time in the middle of the embayment.

C-C'

Cross section C-C' runs 95 km from Brazos County in the northwest where it is 175m thick to Harris County in the southeast where it is 310m thick (Figure 25). This dip-oriented cross section was chosen for its ability to highlight the aggradational to retrogradational nature of the depositional systems in the northeast of the Houston Embayment during the deposition of the Upper Wilcox clastic wedge. This cross section is the furthest east from the Yoakum Canyon region, and therefore is least affected by the embayed shorelines of the lower sequences over Lavaca and Colorado counties. The shoreline in C-C' quickly prograded across the stable substrate provided by the underlying Brazos Delta (Figure 6) and then aggraded and stepped landward through time.

The fluvial log facies present in Sequence 1 shows a strong signal (30 km) of initial progradation as the Upper Wilcox clastic wedge advanced across the muddier substrate of the Middle Wilcox (Figure 25). However, after Sequence 1, all of the log facies begin aggrading and stepping landward through Sequences 2-5 (Figure 25). The delta/ shoreface sandstones that appear stranded in prodelta mud log facies in Sequences 2-4 are the result of the three-dimensional nature of the delta systems (Figure 25). These sands represent the lateral edges of deltas that obliquely cross C-C' but do not run directly along the axis of C-C' (Figure 25).

Cross section C-C' displays the strong aggradational and slightly retrogradational nature of the of the Upper Wilcox clastic wedge facies in the northwest of the Houston Embayment. These shifts are in contrast to the strongly progradational nature of A-A', and to a lesser extent, B-B'. The rapid progradation across the preexisting stable substrate provided by the Guadalupe Delta (Figure 6) of Sequence 1 delivered sediment to the edge of the preexistent shelf. The delivered sediments of the Upper Wilcox were focused in the southwest of the embayment, and what sediment did make it to the shelf edge in C-C' were deposited into soft accommodating muds that strongly growth faulted, stunting further progradation (Edwards, 1981).

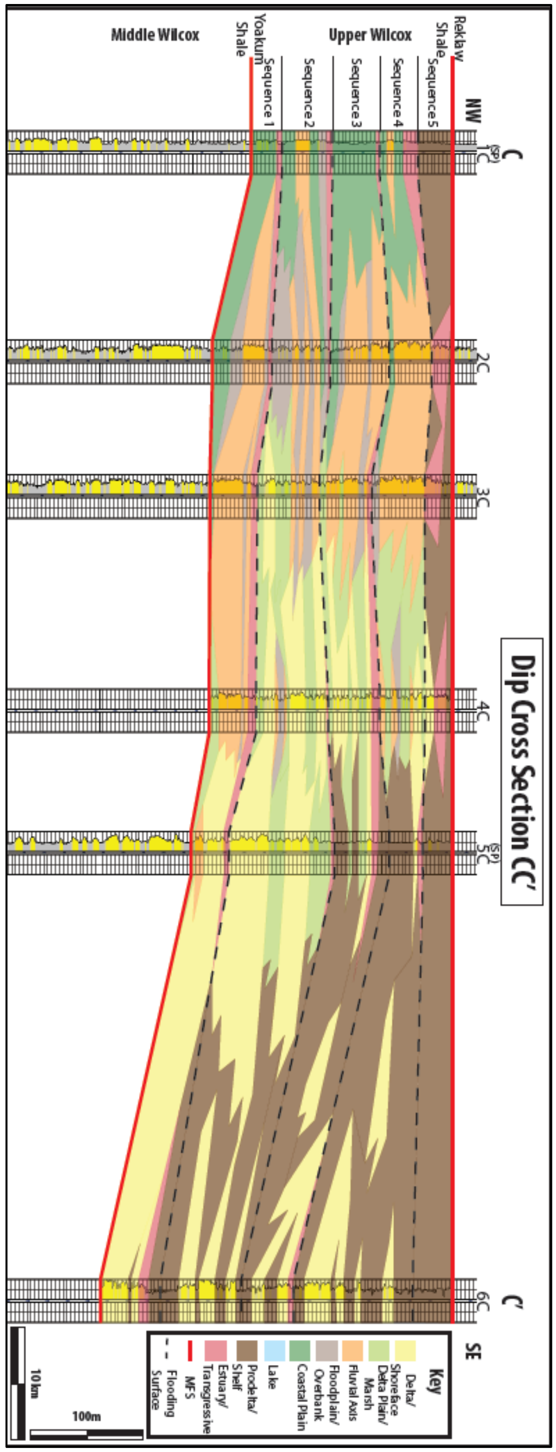


Figure 25: Dip cross section CC'. This cross section shows the strong aggradational to slightly retrogradational nature of the terrestrial system through time in the northeast of the embayment.

Strike Cross Sections

The strike cross sections were constructed in the same way that the dip cross sections were (delineated in the methods section of this thesis), to highlight changes of and interactions between the depositional environments in the Houston Embayment during the Upper Wilcox's deposition. Log signature patterns were interpreted by way of Figure 13. Channel bodies were added to the facies-mapped strike cross sections. Each channel was sized based on the height of the sand body observed in each well and has an aspect ratio of 1:10. Channels were added between wells to reflect interpreted channel movement through the embayment to correspond to the presence of similarly sized channels or lack thereof in nearby wells.

D-D'

The wells in cross section D-D' were selected to help tie the dip cross sections together (Figure 26). D-D' runs 190 km from Gonzales County in the southwest where it is 230m, to Brazos County in the northeast where it is 250m thick. It is located updip in the embayment to contrast how strike oriented depositional environments change in respect to the same environments in cross section E-E', located more downdip in the embayment (Figure 27). For exact well identification numbers and locations see the appendix.

Cross section D-D' shows an overall dominance of alluvial plain and floodplain/ overbank environments with a number of large fluvial systems incising into the substrates. There are some delta plain and delta/ shoreface depositional environments present in D-D', generally in the southwest of the Houston Embayment. These environments reflect the embayed nature of the lower sequences over the Yoakum Canyon region prior to the progradation of the shoreline seen in Figure 23. By following the lateral changes through time of the large channel bodies in DD’, the evolution and movement of the main fluvial systems of the Upper Wilcox can be tracked through the updip regions of the Houston Embayment.

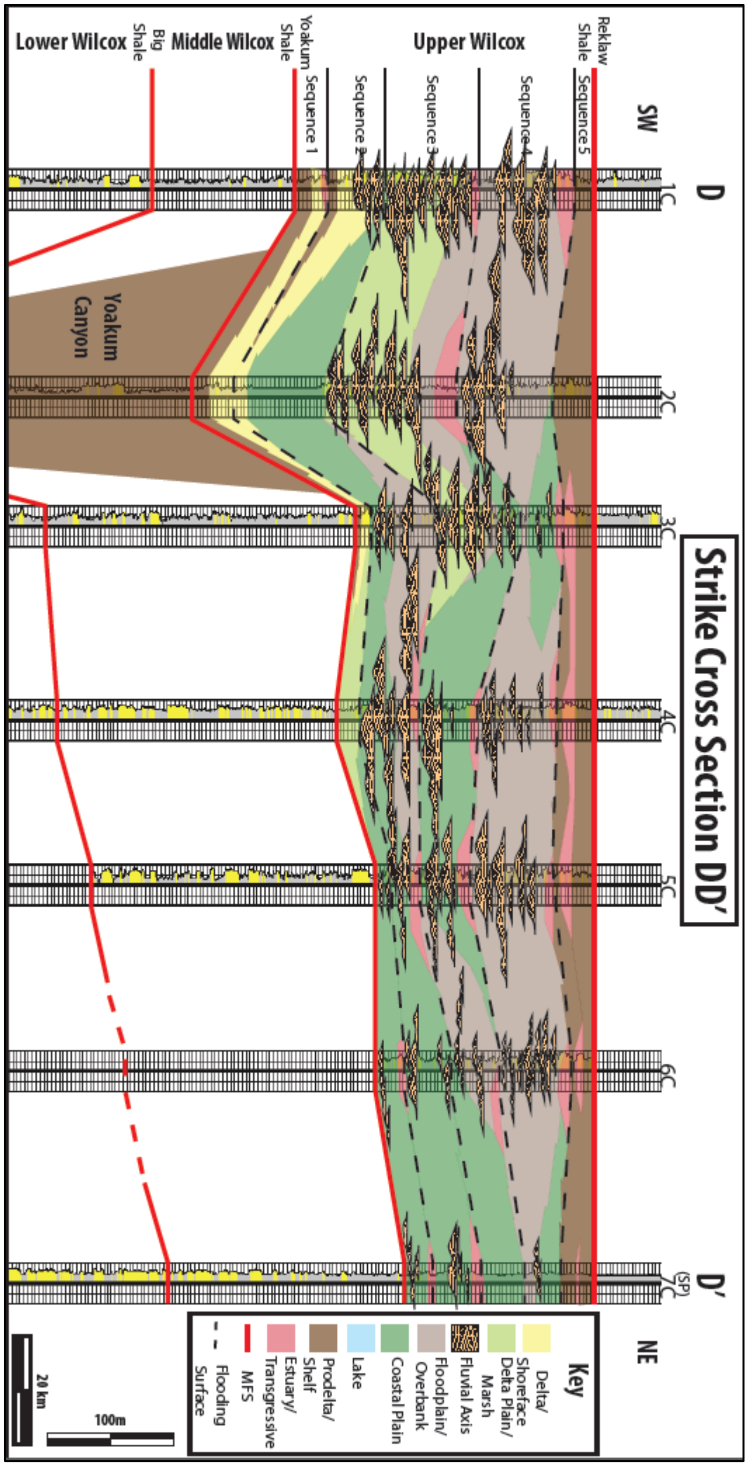


Figure 26: This strike oriented cross section, DD', shows the depositional environments and channel locations in the landward reaches of the embayment.

E-E'

The wells in cross section E-E' were selected to help tie the dip cross sections together. E-E' runs 165 km from Lavaca County in the southwest where it is 380m thick over the Yoakum Canyon, to Waller County in the northeast where it is 200m thick. It was located downdip in the embayment to contrast how strike oriented depositional environments change in respect to the environments in cross section D-D' located updip in the embayment. For exact well numbers and locations refer to the well list in the appendix.

This strike oriented cross section in the downdip region of the embayment highlights the repetitive interactions of terrestrial vs non-terrestrial facies through the Upper Wilcox. Non-terrestrial units make up the majority of the deposits in the southwest in the region over the Yoakum Canyon (Figure 27). This embayment above the canyon can be seen in the maps presented in Section 3.2. The fourth sequence shows almost an embayment wide regression past the wells that make up E-E'. This basinward movement of delta/ shoreface depositional systems across the whole Houston Embayment occurs only after the local embayed shoreline over the Yoakum Canyon reaches a roughly linear or equilibrium state with the rest of the regressive shoreline between Sequences 3 and 4 (observable in the figures in section 3.2).

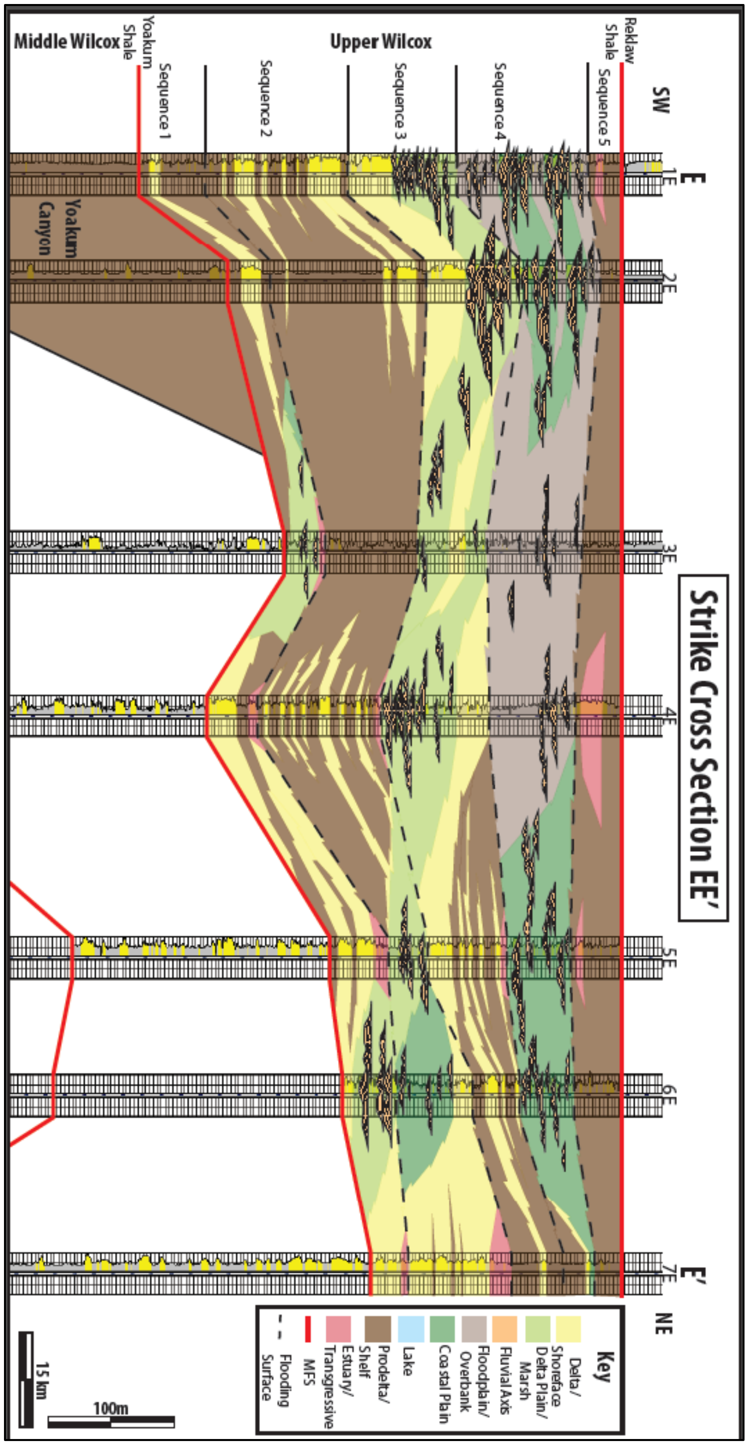


Figure 27: Strike cross section EE'. This cross section shows the depositional environments and channel locations of the Upper Wilcox in the basinward reaches of the embayment.

MAPS

Sandstone thickness maps and log pattern maps were generated in Petra by following the steps delineated in the methods section of this thesis and are derived from data in my database. The paleogeographic maps on the other hand rely more on interpretation than the first two pale-map formats. The paleogeographic maps were created by combining the data from the sandstone thickness maps, the log pattern maps and the prominent points in the cross section descriptions above. By combining the sandstone thickness in any given area with the dominant log pattern at the same location, facies were interpreted and outlined for that area on the map. Due to the variability of a given depositional environment through time, the paleogeographic maps are intended to convey an impression for a single timeline for the described sequence. Ideally the paleogeographic map best represents the depositional environment present at a given location for the pictured sequence, but there are many cases in which the log contains distinct changes in the pattern, and interpreted environment, and these are less well captured.

Sequence 1

Sequence 1 contains both transgressive and regressive deposits in the Houston Embayment. Although the thickness of each half of the cycle varies across the field, the transgressive part can represents up to 70% of the sequence in the landward regions of the embayment.

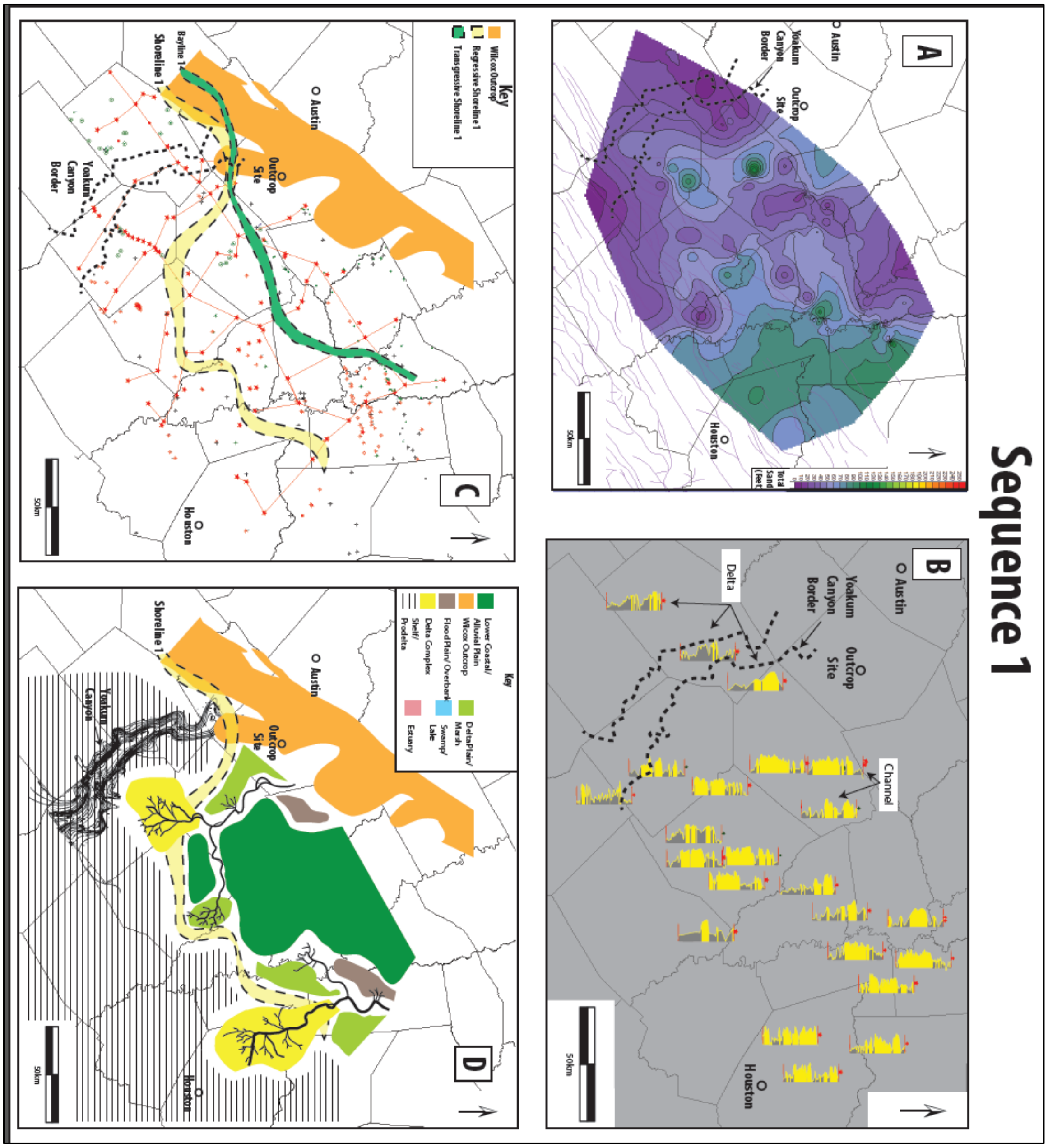


Figure 28: A- Sand thickness map for Sequence 1. One apparent sand fairway exists in the northeast. B- Log Signature map for Sequence 1. C- Transgressive shoreline (bayline) map for Sequence 1. The bayline transgresses significantly in the north of the embayment. Over the Yoakum canyon the shoreline appears pinned to its regressive counterpart. D-Paleogeographic map for Sequence 1. The shoreline is highly embayed over the Yoakum Canyon region. See appendix for full size maps.

Sandstone Thickness Map

Sequence 1 sands lie directly over the Yoakum shale regional marker unit that divides the Middle Wilcox clastic wedge (3rd order sequence) from the Upper Wilcox clastic wedge. The Yoakum shale represents a prevalent (3-12 m (10 to 40 feet) thick), transgressive systems tract capping the Middle Wilcox clastic wedge. Sequence 1 represents the beginning of the progradation of the Upper Wilcox clastic wedge. Many of the channels cross and erode into muds below but are significantly shallower and have a thinner infill than the channel sandstones that will follow in the ensuing sequences.

The individual and stacked channel fills range in thickness from ~3 to 40m (10 to 120 feet) with the general trend of delivery being from north to south as can be seen in Figure 28.A. There is a lack of sandstone deposition in the southwest of the field with the thinnest preserved sandstones centering here. There are two axes clearly visible in the first sequence (Figure 28.A), both flowing in a generally north-south direction. The lack of shore-parallel sandstone deposition strongly suggests that the sandstones that reached the paleo-coastline were at that point fluvial or tidally influenced, rather than wave dominated. Figure 28.A clearly shows the two distinct axis of deposition with the relative lack of sandstone accumulation in the regions between and around the axes.

Log Pattern Map

The sandstones of Sequence 1 have signatures of both terrestrial and marine influences. In much of the updip part of the field, Sequence 1 takes the form of sharp based and topped fluvial channels (as defined in Figure 13). Many of the logs are dominated by channels gaining in grain size through time, suggesting an overall seaward movement of the proximal reaches of channels through time. The upward-fining that might be expected of the transgressive part of Sequence 1 is most noticeable in the northern section of the field in Brazos and Grimes counties. Downdip in the embayment the sandstone signature patterns turn more to an upward coarsening with sharp toped pattern suggesting an increase in downdip regression deposits, that is interpreted as being deposited in a marine/deltaic environment. In the northern section of marine signatures the preserved sandstones range between 21 and 40 m (70 and 120 feet). In the southern margin of the field with marine interpreted signatures preserved sandstone thickness are thinner, between 6 and 15 m (20 and 50 feet) thick. These signatures in the south have more overall sandstone preserved than their more northerly counterparts.

Transgressive Bayline Map

The most landward extent of the transgressive shoreline (bayline) at the top of Sequence 1 runs in a more linear fashion than the regressive shoreline. The bayline bulges slightly in the middle of the field, over Washington and Fayette counties, mimicking the regressive shoreline's tendency from below. The transgressed distance varies greatly across the field; in the region unaffected by the Yoakum Canyon the distance averages around 55 km. The distance transgressed narrows to zero where the Yoakum Canyon heavily embayed the regressive shoreline above Gonzales and Fayette counties.

To explain the lack of transgressed distance in the southwest there are two options that were highlighted in the Cross Section section of this thesis (see Figure 21), heavy sediment supply or a steep gradient. In the case of Sequence 1, both of these factors are likely at play instead of just one. Figure 28.A shows a strong axis of sandstone penetrating the region over the Yoakum Canyon. The forbearers of these sediments could have been supplying the headwaters of the Yoakum Bay during the transgressive period and in so doing kept the shoreline stable. These sediments were originally drawn to this location in the Houston Embayment due to the relative topographic lows above the canyon. The existence of an embayment in the first place indicates a change in topography in respect to the rest of the field. The associated steeper gradient could have also worked to prevent the shoreline from transgressing much over this region.

Paleogeographic Map

Sequence 1 paleogeography highlights the highly embayed shoreline at the base of the Upper Wilcox clastic wedge. The shoreline in the east and northeast has prograded across the inherited stable substrate provided by the underlying Brazos and Colorado deltas of the Lower Wilcox clastic wedge. The deltas of the Lower Wilcox (Figure 6) and the shoreline in the north-eastern portion of Sequence 1 mimic the orientation of the modern shoreline observed today and has been described by various authors (Breyer et al., 2001; W. F. Dingus & Galloway, 1990; W. E. Galloway et al., 2011; William E Galloway et al., 2000; Hargis, 1996; Xue & Galloway, 1995). The Upper Wilcox's shoreline kinking back in the southwest does not follow conventional wisdom. Instead, the shoreline deviates from expected behavior over the location of the Yoakum Canyon.

There are two main fluvial axes interpreted in Sequence 1, one in the northeast and one in the southwest. The northerly axis provided the bulk of preserved sediment to the Houston Embayment in Sequence 1. The preserved channel fills of this axis are individually thick, between 3 and 15 m (10 and 50 feet), but get up to 42.5 m (140 feet) in their amalgamated forms (seen in figures 28.A and 28.B). This axis transitions to marine signatures near the base of Grimes County and the top of Montgomery County (see Figure 1.1.4 for county locations in relation to field area). The resulting marine deposits are varied in their thicknesses but in places achieve thicknesses of up to 42.5 m (140 feet) when incorporating the underlying muds. The river system and associated delta follow a generally linear trend, mirroring the observed axis from Figure 28.A. This lack of shore parallel sandstone deposition deflates possible interpretations of the shoreline being wave-dominated during Sequence 1 as was the case in the Lower Wilcox (Bebout et al., 1979; Edwards, 1980; Fisher & McGowen, 1967; William E Galloway et al., 2000; Jones, 1964; Winker, 1982; Xue & Galloway, 1995). Instead, the shoreline and associated delta is river or tidally influenced at this point.

A majority of Figure 28.D shows a large expanse of the field area interpreted as alluvial plain. This interpretation comes from log signatures containing both muddy strata as well as sandier units. Although the log signatures could be interpreted in a number of ways, the lack of sandstone deposition during Sequence 1 and the variable pattern lend to the interpretation and ensuing labeling of alluvial plain.

The second axis present during Sequence 1 is present in the southwest of the Houston Embayment and runs beside the indented shoreline in the area over the Yoakum Canyon. This axis is smaller than its counterpart in the north, but still delivers sediment to the shoreline and accommodation space of the Gulf. Two swampy regions flank this axis as sandstones are deposited into muddy substrates updip from the interpreted shoreline. The delta present at the terminus of this second axis has upward coarsening sandstone patterns that are up to 18 m (60 feet) thick in places (Figure 28.B).

The deltas in the south are measurably smaller than the deltas in the north. Although the supplying channels are of differing size, there could be another explanation for the variability in extent and thickness. The deltas in the northeast would have been entering accommodation space generated by an inherited Lower Wilcox shelf edge, quite a sizeable amount of space available for deposition and progradation. However, the deltas in the southwest were depositing their sediment around 75 km back from the inherited shelf edge. This accommodation space was only equal to the depth of the

Yoakum canyon that had not been infilled prior to the progradation of Sequence 1, a depth that will be the subject of debate, but nowhere near as deep as the depth encountered in the north-east during the equivalent time period.

Sequence 2

Sequence 2 has both regressive and transgressive deposits preserved in the embayment. The sediment deposited during the regressive half dominate log patterns in the basin whereas sediment deposited in the transgressive stage constitute the majority of logs in the updip reaches of the Houston Embayment.

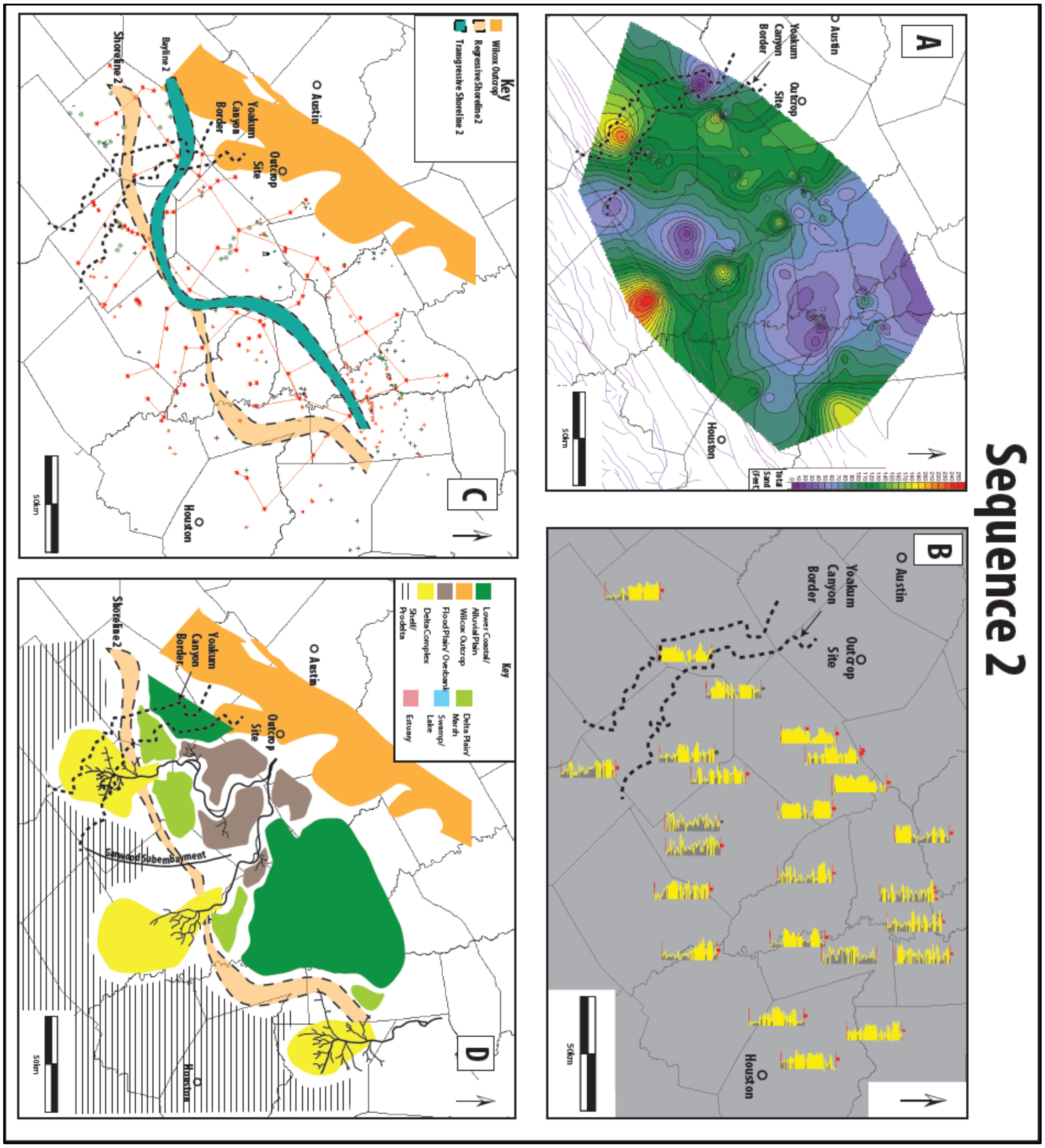


Figure 29: A- Sand thickness map for Sequence 2. Considerably more sand than the first sequence (Figure 28.A.). There is a very large fairway entering and filling the Yoakum Canyon in the southwest of the embayment. B- Log Signature map for Sequence 2. C-Transgressive shoreline (bayline) map for Sequence 2. The bayline failed to transgress in the middle of the embayment where it is pinned over Lavaca and Colorado counties. D-Paleogeographic map for Sequence 2. The shoreline had prograded significantly from Sequence 1 (Figure 28.D). See appendix for full size maps.

Sandstone Thickness Map

Sequence 2 has considerably thicker sandstone content than Sequence 1 below. Thickness in Sequence 2 ranges from 3 to 73 m (10 to 240 feet) with the sandstones thickening from the north to the south southwest. The NE-SW sand delivery axis seen in Sequence 1 is no longer significant on Unit 2, whose delivery axis shifted more to the northeast, leaving the Houston Embayment. What sand that does make it to the region from the northern axis continues to show a weak north to south delivery pattern. The larger of the two Sequence 2 axes, entering from the northwest shows a massive surge of preserved sediment in comparison to the underlying deposits of Sequence 1 in the region.

The largest axis of delivery continues to run from the north into the south but this Sequence has a major fork in the delivery of the sands in the east of Fayette County. The smaller of the resulting two axes delivers sediment into the depocenter centered on Fort Bend and Wharton counties that was previously influenced by the axis flowing into the embayment from the northeast. This change may indicate a small-scale reorganization of the fluvial systems updip of the embayment area or of an avulsion to the northeast leaving accommodation space behind for the northwest axis to occupy. If the change in dominant axis is in fact due to a reorganization of the updip fluvial system, it would be in concert with the larger overall tectonic pattern pulling fluvial systems to the southwest (Galloway et al., 2011)

Most of the sandstone in Sequence 2 exists right above the location of the Middle Wilcox Yoakum Canyon or in the system feeding said sandstones. The axis comes in from Bastrop and Lee counties and then continues south-southwest into the Yoakum region. This strong axis of sand delivery accounts for the majority of sandstone preserved in Sequence 2. In Sequence 1, this depocenter provided accommodation space below an embayed shoreline. In the following sequence the sediment in the Houston Embayment funnels to this area, prograding and depositing through the accommodation space that exists "behind" the rest of the shoreline in the region. Put simply, sediment is drawn to the local topographic low in the Houston Embayment that exists above the Yoakum Canyon.

The log signatures of this axis are thick and sharp based, interpreted as channels in the updip part of the embayment and change to upward coarsening signatures interpreted as marine/deltaic in the southwest of the embayment. The individual preserved channel fills range between 3 and 18 m (10 and 60 feet) thick and in their amalgamated forms get up to 45 m (150 feet) thick. These values are relatively similar to those of Sequence 1, the difference being that the areal extents of these thick deposits in Sequence 2 are more expansive. Some of the thickest sandstones occur as marine packages in the downdip reaches located in Lavaca and Dewitt counties as well as in Wharton County.

Log Signature Map

There are two main patterns of log signatures in Sequence 2, terrestrial and marine. Some, like the westernmost log, contain both patterns. An immediate upward coarsening signature, for the lower one-third of the thickness is interpreted as the main regressive deltaic shoreline, whereas two larger sharp-based sandstone units are interpreted as channels in the upper part of the sequence. This log displays both a regressive succession at the base, and likely a transgressive one at the top (at least the upper channel). In such an interpretation the lower sandstone unit would be the delta distributary channel, whereas the upper one would be a transgressive estuarine channel complex. Logs in the southeast of the embayment thus show strong deltaic signatures, albeit with some significant prodelta or lower delta-front muddy portions beneath the sandstones. Patterns in the northernmost region of the embayment show a strong "ratty" signal of muddy strata punctuated with thin, 10<m, sandstones throughout. Sandstone patterns in and above Fayette County show the thick (30m) sharp-based sandstone packages of the main channel axis of Sequence 2. These channel sandstones are mostly amalgamated, reaching thicknesses up to 45 m (150 feet), muddy overbank deposits are interspersed between these channel deposits. The general depositional trend is along the southwestern half of the embayment leading to a relative lack of deposition in the northeastern region of the embayment, though there is a fair amount of delta-front sandstone in the sequence just north and northeast of Houston. These observable depositional trends are present in both Figures 29.A and 29.B and are interpreted in Figure 29.D.

One of the presented logs, in the north of Austin County appears upon first inspection to have an upward coarsening pattern that could be interpreted as marine. Although the pattern looks that way upon first appraisal, the coarser sandstones have sharp bases, are separated by distinct muds and are discontinuous from each other resulting in a channelized terrestrial interpretation. The trend of the individual sandstone bodies to increase grain size through time may be indicative of either a progradational fluvial system moving down dip, or a meandering one moving laterally over this well's position through time.

Some the logs in the downdip and easternmost regions of the embayment display thicker upward-coarsening packages near their bases, recording a strong regressive signal. Identifying the transgressive patterns in the updip regions is more challenging.

The channels preserved in the upper sections of the logs, most easily seen in Lee and Fayette counties could represent channelized estuary deposition during the transgressive stage.

Transgressive Bayline Map

Unlike the regressive shoreline in Sequence 2, the bayline contains a serious bulge observable over Lavaca and Colorado counties. To the west of this protrusion, the bayline has transgressed around 25 km. The transgressed distance in the eastern region of the embayment is highly variable, around 50 km over Austin County down to only 8 km in Grimes County. The lack of transgression and effective pinning of the shoreline in the middle of the embayment was likely due to a heavy sediment supply. Figure 29.A shows a strong fairway of sediment traversing this region which prevented the shoreline from transgressing any meaningful distance landward. This lack of transgression in this shoreline segment corresponds to the partial and final infilling of the accommodation space above the Yoakum Canyon that Sequence 2 accomplished, detailed in Fig. 29D.

Paleogeographic Map

The most drastic change immediately noticeable between Sequence 1 and Sequence 2 is the significant basinward progradation of the shoreline over the Yoakum Canyon region. The shoreline appears to be hinged along the northeastern edge of Lavaca County, swinging down and coming closer to being in line with the rest of the shoreline in the Houston Embayment. There are also three deltas in Sequence 2. The swamplands that were updip of the shoreline in Sequence 1 located on the border between Austin and Colorado counties have prograded to become an elongated fluvial-dominated delta. The presence of three simultaneous deltas extending beyond the most landward extent of the non-terrestrial facies in Sequence 2 is the closest to Miller's overall depiction of the Upper Wilcox as described as a clastic wedge (third order sequence) in this dataset, although Miller's deltas were set closer together (Miller, 1989) (see Figure 9).

A relatively small delta complex entered the region from the northeast. Unfortunately, the current dataset does not have complete coverage of the system that supplied these marine sandstones. It can be deduced that the fluvial system present in the most northerly portions of Sequence 1 has shifted to the north and this delta is the resulting depositional body deposited to the south, entering the dataset.

Fluvial input in Sequence 2 comes almost entirely from the northwest of the embayment. There are two distinct sandstone trends, one running north-south and the other northwest-southeast. The north-south axis is composed of a series of stacked fluvial channels whose individual fills are up to 18 m (60 feet thick) with amalgamated bodies getting up to 45 m (150 feet) thick. These sandstones appear to be pulled into the local topographic low provided by the incompletely filled Yoakum Canyon below. Some of the thickest deposits in Sequence 2 exist where the north-south axis encounters the most landward extent of the shoreline, depositing sediment into standing water. These marine signatures get up to 60 m (200 feet) thick in places throughout the southwestern quarter of Lavaca County. The sandstone distribution, like in Sequence 1, lacks a shore parallel trend, once again indicating a fluvial or tide dominated delta system.

The second branch of the fluvial axis entering from the northwest traverses Fayette and Colorado counties along a northwest-southeast trend. The patterns in this region show distinct channel bodies that are individually as thick as those of the main axis, but are more segregated by muddier interfluve deposits resulting in a less amalgamated deposit. These patterns result in floodplain as well as coastal plain interpretations over Fayette and Colorado counties in Figure 29.D. When these channels reach the landward limit of the coastline, they deposit great quantities of sands into standing water generating upward coarsening log patterns interpreted as deltas that reach up to 30 m (100 feet) in places. The trend of sandstone distribution for this body also reinforces the lack of wave influence on the delta's morphology.

Sequence 3

Like in Sequences 1 and 2, Sequence 3 contains both a regressive and transgressive signal in the preserved sediments. Although thicknesses vary across the embayment, transgressive signals can be seen constituting up to 80% of the logs in the updip reaches of the embayment. Regressive signals similarly dominate the log pattern in the downdip regions of the embayment.

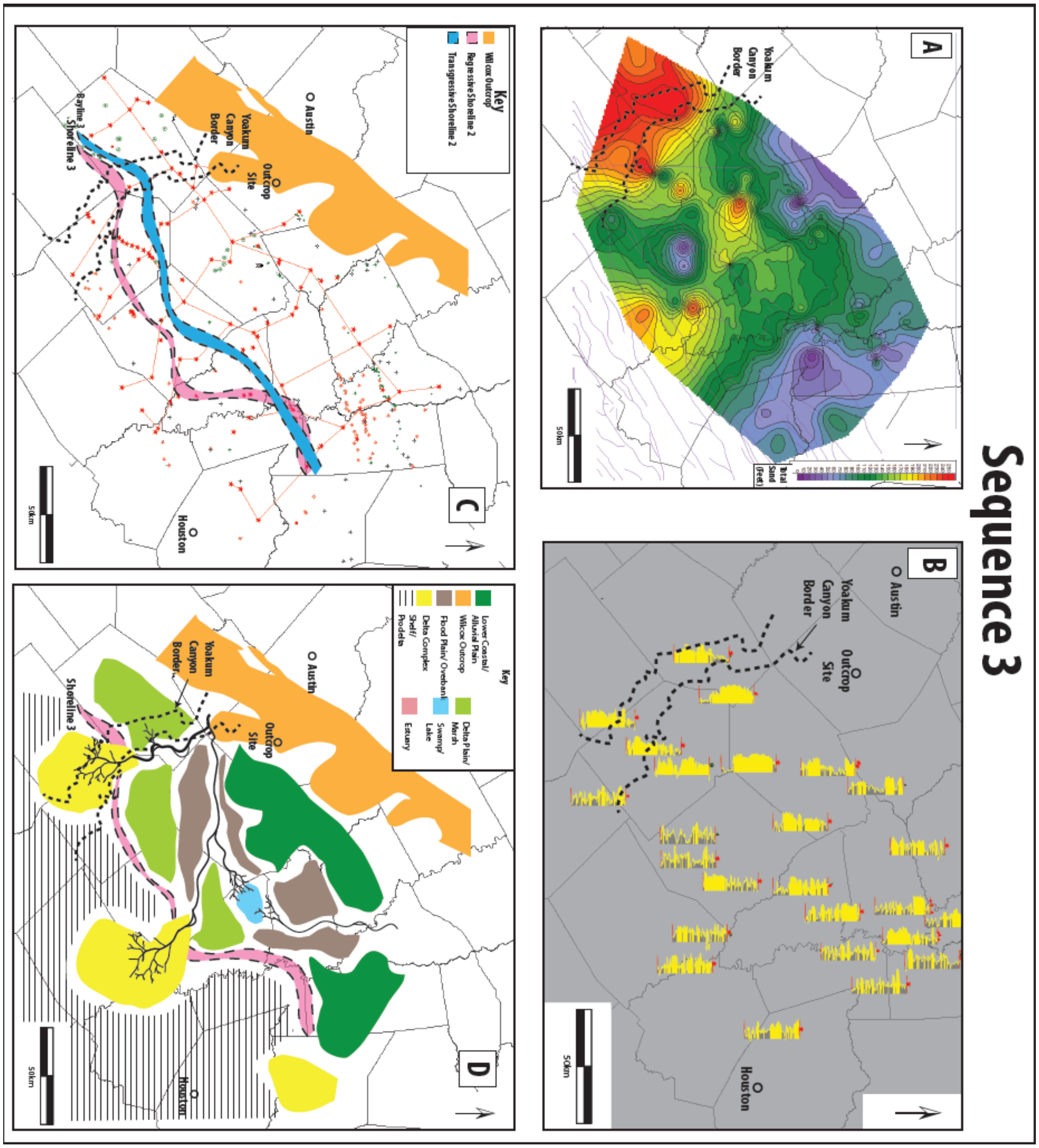


Figure 30: A-Sand thickness map for Sequence 3. There appear to be two sand fairways, one in the northeast and the larger exists over the Yoakum Canyon. B-Log Signature map for Sequence 3. C- Transgressive shoreline (bayline) map for Sequence 3. The bayline transgresses in the middle of the embayment. In both the northeast and southwest the shoreline fails to transgress significantly. D-Paleogeographic map for Sequence 3. The shoreline is getting closer to being roughly linear. There is a transient lake in the middle of the embayment. See appendix for full size maps.

Sandstone Thickness Map

Sandstone content in Sequence 3 achieves total thicknesses that exceed any of the other 4th order sequences that compose the larger Upper Wilcox clastic wedge. Sandstone units aggrading over the location of the former Yoakum Canyon reach a thickness of 73 m (240 feet) in places. It has been suggested that his extreme thickness can be attributed to compaction of the underlying muddy canyon fill, resulting in sediment being drawn to fill this accommodation space, or to fill the preexisting space downdip of the shoreline over the canyon. The compaction of Yoakum canyon-filling muds resulting in thicker overriding sequences has been suggested by Dingus and others (W. F. Dingus & Galloway, 1990; W. E. Galloway et al., 1991; McDonnell et al., 2008; Winker, 1982; Xue & Galloway, 1995). These channels are the largest of any of the fluvial or fluvial-tidal deposits in the Upper Wilcox, which generally range from 6 to 24.5 m (20 feet to 80 feet) in thickness. The prevalence of amalgamation and deep erosion of these sandstones make the identification of individual channels challenging; whole packages of amalgamated channels reach 45.5 m (150 feet) in thickness.

The southwestern half of Lavaca County was also inundated with sandstone, partly as channel fills and partly as upward coarsening delta-front units up to 21 m (70 feet) thick in places. The delta front packages develop upwards from muddier prodelta deposits.

The main axis entering from the northwest splits between Gonzales and Fayette counties, much like the underlying system did in Sequence 2. This fairway divergence traverses to the southeast and appears to merge with a smaller channel fairway entering the embayment from the north that has a north-south trend. These fairway axes merge in

Colorado and Fayette counties, delivering their sediment to the southeast. The northern input has channel deposits ranging from 3 to 9 m (10 to 30 feet), with amalgamated deposits getting up to 15 m (50 feet) thick.

Regions in the northeast of the area are relatively lacking in thick sandstone units, with Harris and Montgomery counties only accumulating up to 18 (60 feet) total meters of sandstone on average. Lee County also has a dearth of sandstone with only 6 m (20 feet) present in places.

Log Signature Map

The most striking features displayed by Figure 30.B are the preserved channel bodies that fill almost the entirety of Sequence 3 over the region of the Yoakum Canyon in Lavaca and Fayette counties. The patterns show that these bodies are not single channels, but instead are punctuated throughout with higher gamma ray signatures indicating short periods of lower energy and deposition of finer material. However, these intervals of higher gamma-ray reading are few and far between in the main axis of fluvial deposition, and in many of these logs the finer material never breaks above the 75 API cutoff to be categorized as material finer than sandstone. The channels here are more likely to be attached to the regressive deltas in the lower part of the succession but with the transgressive estuaries in the uppermost levels. The change from regressive up to transgressive can be difficult to pick without core data.

In the north, there are smaller channels present in Sequence 3, running in a southerly direction. These bodies are more clearly partitioned by muddy intervals of overbank/ floodplain deposits. This dispersal axis meets with a smaller fairway entering from the northwest, at which point the sandstone bodies appear to thicken somewhat around Austin and the eastern region of Fayette counties.

"Ratty" log signatures define the counties in the northeast of the embayment area. These signatures are caused by thin sandstone bodies within larger muddy matrixes as previously noted in Figure 30.A.

Marine delta-front successions occur in the southern and southeastern, down dip portions of the embayment, such as in the west of Harris County where classic upward-coarsening log patterns can be seen. These marine muddy to sandy units terminate with sharp tops and a return to muddy intervals above.

The downdip areas preserved more sediment during the regressive phase of Sequence 3, preserving upward coarsening packages throughout most of the log. The updip areas, in contrast, preserve mainly channel deposits, and the uppermost channel fills can be attributed to the transgressive, estuarine phase of the sequence.

Transgressive Bayline Map

In Sequence 3 the bayline runs much closer to the regressive shoreline than in the two preceding sequences. Both ends of the embayment show the bayline's position as pinned to the regressive shoreline's location. Through the middle of the embayment the transgressed distance averages around 20 km with a maximum of 30 km over Austin County. This roughly parallel nature of the two lines is explained by the ubiquity of sand delivery across the embayment in Sequence 4 (Figure 31.A). The transgressive tendency was muted by the high supply of sands that were being delivered to Sequence 4 across the whole region.

Paleogeographic Map

Sequence 3 shows a very similar landscape to Sequence 2 below. The shoreline over the Yoakum Canyon region remained largely in the same place, and the two branching forks of the main fluvial axis follow the same trends and patterns. The feature that most distinguishes Sequence 3 paleogeography is the swamp/lake present in the middle of the embayment in the northwest of Austin County.

This interpreted lake succession consists of repeated upward coarsening packages of muds with some small sandstones near the top with sharp capping surfaces (Figure 30.B). These patterns differ from their marine counterparts in three key ways: they are thinner, only 21 m (70 feet) thick at most, muddier, and occur in an area with terrestrial log signatures on all sides. Deltas on the other hand are commonly up to 61 m (200 feet) thick, are topped with thick sandstone packages, and have prodelta mudstones on at least one side within the same sequence.

Figure 30.D depicts the smaller northern axis feeding the lake in the middle of the embayment. This figure represents one moment in time, whereas in reality the northern fluvial axis probably merged with the smaller of the more southerly axis to feed sediment to the shoreline and depocenter over Wharton and Fort Bend counties. This combined or single fluvial axis runs perpendicular to the paleo-shoreline, i.e., northwest-southeast, in a direction noted by previous workers (W. E. Galloway et al., 2011; Hamlin, 1983; Miller, 1989). This study finds that a majority of the fluvial axes in the Upper Wilcox ran in a north-to-south trend, in large part to fill the open accommodation space of the Yoakum Canyon that was south of the fluvial inputs. This interpretation is reinforced by 56 paleoflow measurements from Bastrop County (Figures 35-37) that have an average flow direction of 170°.)

The largest fluvial axis running over Gonzales and Lava counties largely maintains the location of its predecessor in Sequence 2. The sandstones in Gonzales County are particularly striking, as the shoreline did not prograde very far in this region between the two sequences, the river systems have aggraded over the same region for the entirety of Sequence 3. This increased weight of sandstone compacted the muds below in Yoakum Canyon, generating more local accommodation space for these rivers to fill and amalgamate in. The compacting muds in effect trapped this fluvial axis in the region over the canyon without easy respite to avulse across the rest of the embayment.

There is a small deltaic input to the embayment from the north. This dataset does not cover the region updip from this delta, and therefore cannot shed light on the fluvial system/axis feeding the sediment. The sandstone thickness values however are meager in the region, implying that the fluvial input was not strong relative to the axes pictured, or that the input was far enough away from the study area that only the fringes of deposition we captured in this dataset.

Coastal plain environments were assigned to regions of Sequence 3 that had very little sandstone content. These areas could have been local highs at times, generating regional interfluves.

Sequence 4

The fourth sequence contains both transgressive and regressive deposits reflecting both halves of the sequence. Thicknesses vary across the field, but regressive deposits in the downdip reaches achieve up to 100m of total thickness.

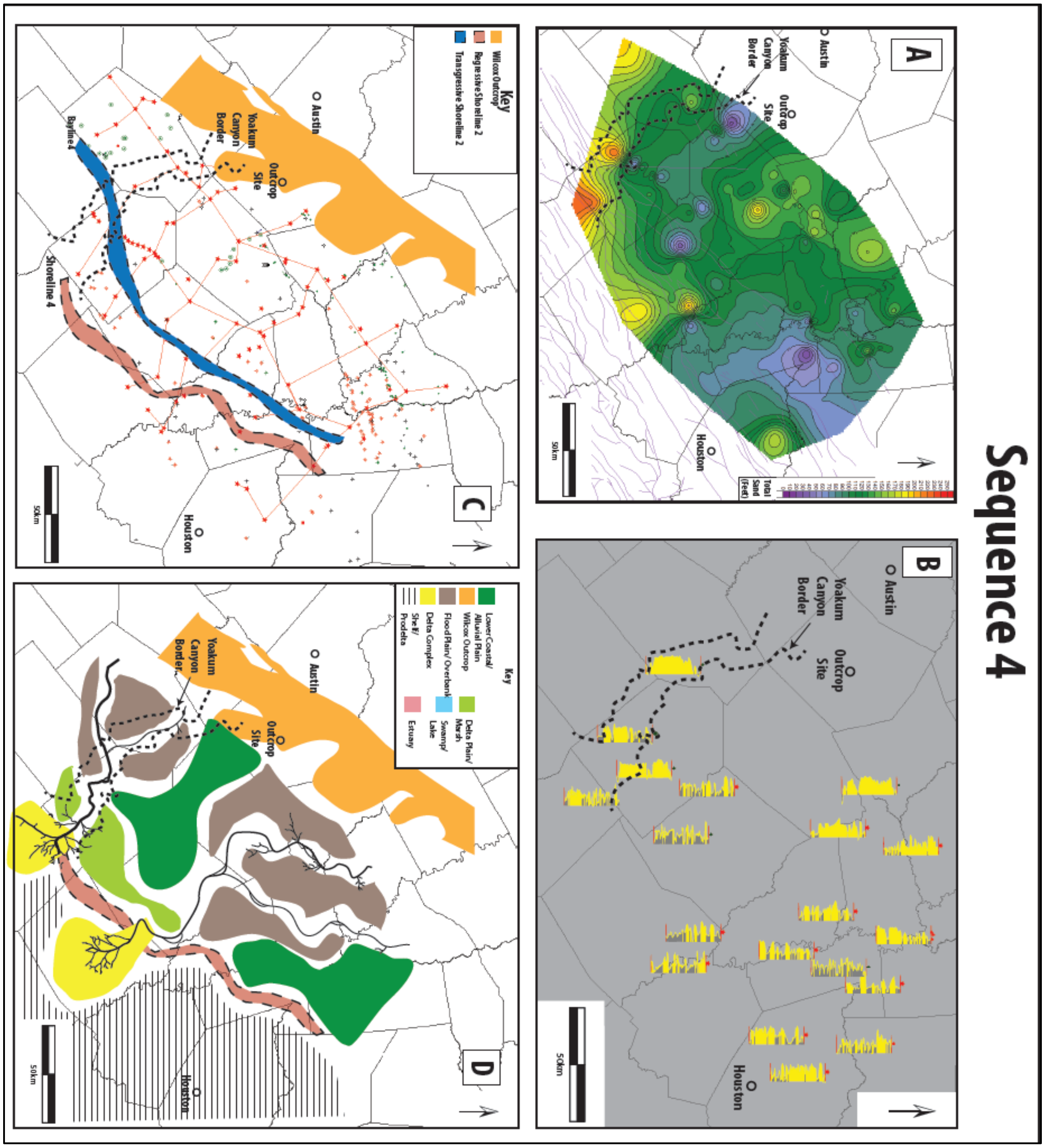


Figure 31: A-Sand thickness map for Sequence 4. Almost the entire embayment is inundated with <100 feet of sand. B-Log Signature map for Sequence 4. C-Transgressive shoreline (bayline) map for Sequence 4. The entire bayline transgresses a fairly uniform distance from the underlying regressive shoreline. D-Paleogeographic map for Sequence 4. The shoreline has prograded fully across the Yoakum Canyon region and is in line with the rest of the shoreline in the embayment. See appendix for full size maps.

Sandstone Thickness Map

Sequence 4 shows a prevalence of sandstone ranging between 30.5 and 45.5 m (100 and 150 feet) thick, across most of the Houston Embayment. In contrast to the underlying sequences, it is challenging to identify a single main fluvial axis in Sequence 4, based solely on the sandstone thickness maps. The only location that can constrain one such point is in the eastern region of Colorado County where thicker sandstones appear bottlenecked between areas of relatively thin sandstone accumulation on either side.

There are two regions that do not have significant sandstone accumulation in Sequence 4: one covering Waller and Harris counties in the east, the other beginning in Bastrop County and running southeast into Colorado County. Sandstone thicknesses in these areas get as low as 9m (30 feet) in places and are commonly 15 to 18 m (50 to 60 feet) thick.

Much of the middle of the Houston Embayment in Sequence 4 is comprised of thick, widely dispersed sandstones that extend from Fayette County in the east to Grimes county in the west, around 150 km. This expanse of sandstone is hemmed in on either side by the previously identified low-sandstone regions running in a more north-south manner, the containment culminates at the thinnest point of thick sandstones over Colorado County.

In the east of the Houston Embayment some of the thickest sandstones have a northwest-southeast orientation. Unfortunately this dataset only captures the eastern-most reaches of this sandstone body. These sandstones reach up to 55 m (180 feet) in the terrestrial updip regions, and are largely made up of amalgamated sandstone channel fills. Downdip from these channels the sandstones fill the last of the available accommodation space inherited from the mostly filled Yoakum Canyon. The upward-coarsening log patterns that occur downdip of the channels are interpreted to be deltas reaching thicknesses of 15 m (50 feet). Where the sandstones are very thick they are made up of many distinct upward-coarsening packages vertically separated my muds ranging in thickness between 0.6 and 3 m (2 and 10 feet).

Log Signature Map

One signature that stands out comes from the well location in Gonzales County. This log pattern shows the location of the main fluvial axis for Sequence 4. These patterns appear to transverse Lavaca County en-route to the downdip, upward coarsening signatures of the associated deltaic shoreline. The channelized deposits in Gonzales County are 27.5 (90 feet) thick and comprised of many smaller channels averaging 3 to 6 m (10 to 20 feet) in thickness. This axis is erosive but was contained in the same location over a long enough time to not allow muddy strata to develop between the individual channel fills. The most likely scenario is that some of the individual channels in the base were deposited during regression, and the upper channels associated with the general upward fining were deposited during transgression. Unlike the well in Gonzales County the wells observed downdip within the same axis have preserved sandstones that are still quite thick, up to 15 m (50 feet) in places, but are more commonly divided by muddy strata.

There was also a large fluvial input entering the embayment from the north that can be observed on the map in Lee and Washington counties. These signatures have individual channel fills reaching 12 m (40 feet) that in places erode into each other generating stacked and amalgamated channel fills reaching up to 36.5 m (120 feet) thick.

This input becomes more dispersed through the ensuing downdip log patterns that show smaller channels with more muddy strata preserved between individual channel fills.

In the south of Austin and northeast of Fort Bend counties there are two wells with typical deltaic log signature patterns. These wells show a repeating pattern of muds coarsening up into sandstones that turn into coarser sandstones then are finally capped by a sharp top and the return of fine grained muds. These interpreted deltaic signatures can reach 54.8 m (180 feet) thick.

Wells in Fort Bend, Austin, and Colorado counties highlight deposition during the regressive phase of Sequence 4 with their preserved upward coarsening packages. Once again, recognizing a distinct transgressive signal in the channels updip is challenging. However, many of the sandstone bodies in the north and northeast of the embayment in the upper levels of the wells were most likely deposited during transgression.

Transgressive Bayline Map

Sequence 4's bayline runs roughly parallel to the regressive shoreline below. The average shoreline transgressive distance is between 15 and 20 km and expanded slightly in the southwest of the embayment. Unfortunately the regressive shoreline is unidentifiable in the southwest corner due to a lack of wells in the region over Dewitt County. The lack of any shoreline pinning is explained by the lack of variable gradient across the Houston Embayment by the time the shoreline transgressed at the end of Sequence 4. The previous sequences of the Upper Wilcox Clastic Wedge worked to fill in any outstanding accommodation space, resulting in a fairly level region by the time of transgression in Sequence 4.

Paleogeographic Map

The shoreline in Sequence 4 finally came into an orientation with the rest of the coastline in the northeastern region of the embayment that has stayed relatively stable throughout the underlying sequences of the Upper Wilcox. This progradational movement of 20 km represents the end of any trace of influence of the earlier Yoakum Canyon on morphology of the Upper Wilcox during Sequence 4 and above. Although the muds of the canyon may have continued to compact somewhat when looking at the shoreline in map view, as is seen in Figure 31.D, an observer would see a roughly linear shoreline with no indication of an embayed region over a topographic low.

This prograded shoreline was fed by the largest fluvial system during the development of Sequence 4 that runs across Gonzales and Lavaca counties. These sandstones cross the shoreline and enter the open ocean at the border of Lavaca and Jackson counties. The thick resulting deltaic deposits are not composed of overly large deltas; instead they consist of many repeating small deltas that do not exceed 21 m (70 feet) for any given package. The dataset does not extend far enough to the south to determine the sand distribution of this delta system, it is assumed that it follows the pattern of the deltas in pervious sequences and is either fluvial or tidal dominated.

A second smaller fluvial system entered the embayment from the north in Burleston County and was quickly thereafter joined by a third, the smallest, river entering from Brazos County. These systems meet roughly in the same region that hosted the lake of Sequence 3 below (Figure 30.D). This region could be a topographic low throughout the period of the Upper Wilcox, attracting fluvial systems in each sequence. This low seen in multiple 4th order sequences in the Upper Wilcox corresponds to an inter-deltaic space in the Lower Wilcox. Much of the Upper Wilcox morphology appears due in part to the preserved underlying topography of the Lower and Middle Wilcox. If this is the case, the lack of a stable substrate of deltaic sandstones in the region would lead to the observed lows through the overriding sequences as the accumulated weight compressed into the muddy inter-deltaic space of the Lower Wilcox. This system entering from the north contributed to the omnipresent collection of preserved sandstones that make up most of the north of the map. The systems avulsed and switched paths frequently in Sequence 4. The depicted rivers are representative of one point in time, but the adjacent floodplain deposits also play host to channel bodies at times. Eventually this axis reached the landward extent of shoreline and deposits its sediment into the depocenter over Fort Bend and Wharton counties.

Two regions contain relatively less sandstone than the rest of the embayment in Sequence 4; they are assigned as alluvial plain environments in Figure 31.D. The ratty nature of their deposits and lack of sandstone make them unique in Sequence 4. They act to hem in the overly sandy axis entering from the north, eventually narrowing the axis to just 40 km between the most southerly extents of the alluvial plain environments.

Sequence 5

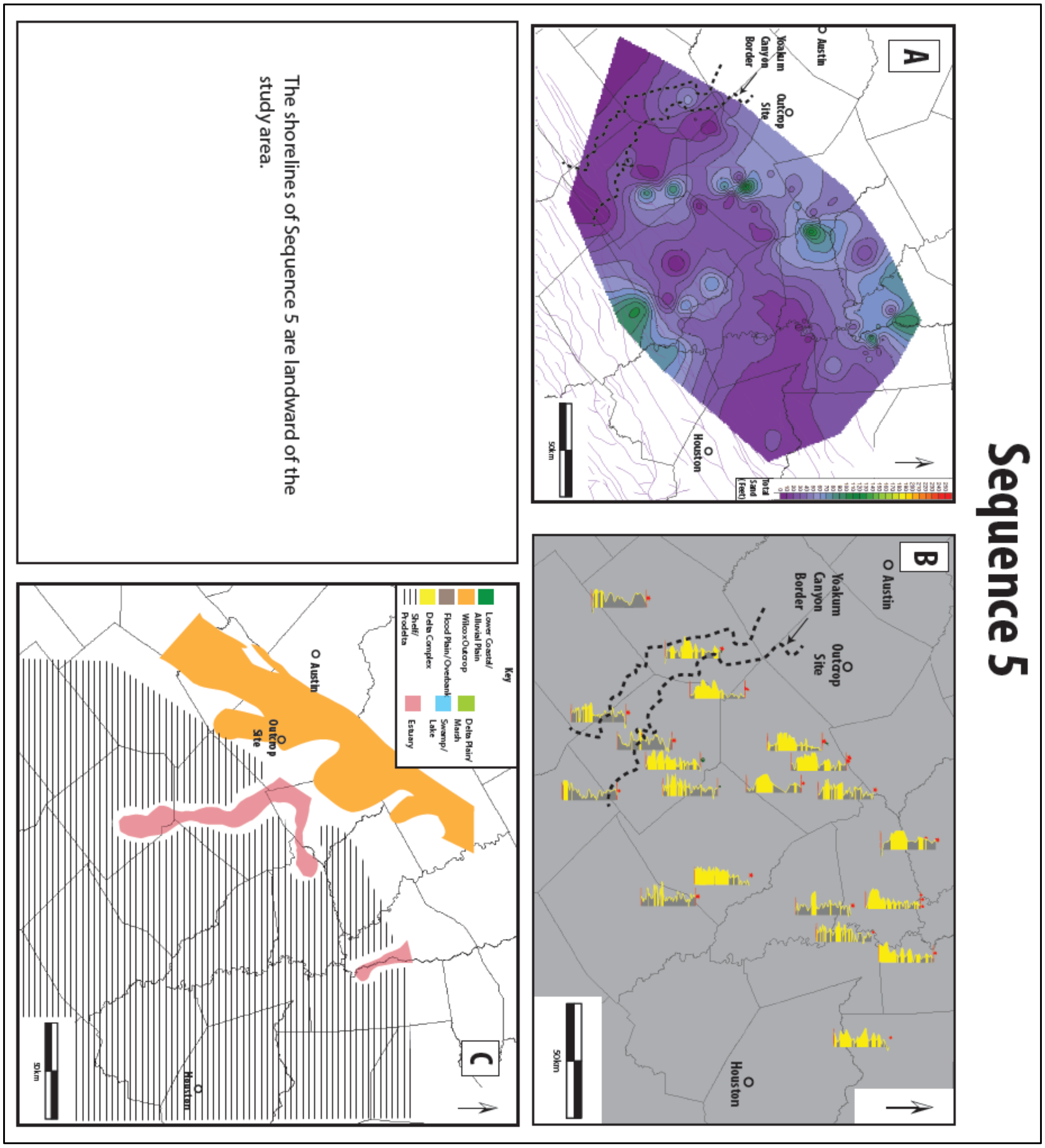


Figure 32: A-Sand thickness map for Sequence 5. Very little sand makes it to the embayment in the last sequence of the Upper Wilcox. B-Log Signature map for Sequence 5. C-Paleogeographic map for Sequence 5. The shoreline has transgressed beyond the study area. There are some preserved estuary deposits in pink. See appendix for full size maps.

Sandstone Thickness Map

Sandstone thicknesses in Sequence 5 are much thinner than those preserved in Sequences 2-4, ranging between 3 and 30.5 m (10 and 100 feet) in thickness. This lack of significant sandstone preservation reflects the dominantly transgressive and back-stepping nature of this final 4th order sequence within the Upper Wilcox clastic wedge. The preserved sediment of Sequence 5, whether sandstone dominated or mudstone dominated, all fine up into the regional Reklaw Shale that demarks the upper extent of the Upper Wilcox clastic wedge. One sandstone trend that does exist in Sequence 5 runs north-south through Fayette and Lavaca counties. These sandstones reach up to 30.5 m (100 feet) in places, but are more commonly in the 15-18 m (50-60 feet) range.

The north of the Houston Embayment also played host to some preserved sandstones. Here in Washington and Grimes counties local pockets of sandstone reached total accumulated thicknesses of 36.5 m (120 feet).

Most of the Houston Embayment in Sequence 5 consists of thin sandstone accumulations. The eastern-most and western-most regions contain the least sandstone accumulation with average values around 10 to 6 m (20 feet) of preserved sandstone. The middle of the embayment only has slightly more sandstone, averaging around 9 to 12 m (30 to 40 feet) on average.

Log Signature Map

All of the wells in Sequence 5 show the upward fining indicative of a back-stepping sequence. The wells with most sandstone content exist in a linear distribution observed in Figure 32.A and can be seen in Figure 32.B running roughly north-south through Fayette and Lavaca counties. These sandstones typically have sharp erosive bases sometimes followed by similar sharp based sandstone, but always eventually capped with an upward fining succession of fine-grained sediment. Another pocket of these sandier units exists in the counties just north of Austin County. These sandstones lack the linear trend displayed by their more southerly counterparts, and therefore could be closer to a paleo-shoreline not observed in this dataset in the north or northeast. Many of these transgressive patterns reach >33 m (hundreds of feet) in total depth, with the thickest packages reaching 91.5 (300 feet) of total thickness.

As is expected, there are little to no preserved regressive deposits in the embayment during Sequence 5. Instead, all of the preserved sandstones are the result of the region-wide transgression that culminated in the deposition of the Reklaw Shale.

Paleogeographic Map

The prevalent upward-fining grain-size patterns of Sequence 5 all represent a regional transgression of the Texas coastline at the end of the Upper Wilcox. The resulting thick, up to 15 m (50 feet) in places, Reklaw Shale regionally signals the end of all of the Wilcox input into the Gulf of Mexico.

What few sandstones that are preserved are interpreted as estuary sandstones. They are characterized by >50 m (100's of feet) thick packages with erosive sandstone bases capped by upward fining deposits. The largest preserved estuary runs roughly north south in the embayment through Fayette and Lavaca counties. This estuary runs along the same trend that the largest fluvial axes ran throughout the underlying sequences. This repeated lineament of fluvial axes acted as a guide for the final incised valley/estuary to take over. The ravinement surface that eroded the other sediments of

Sequence 5 was unable to fully erode this region that played host to the strongest fluvial axes through the Upper Wilcox.

The shoreline during Sequence 5 existed updip from the study region of the Houston Embayment. Some sands do make it into Sequence 5 at the bottom of the large, upward fining succession. Therefore the majority of the embayment is considered prodelta/shelf during Sequence 5.

OUTCROP RESULTS

Outcrops were measured in the Bastrop Lost Pines neighborhood. The exposed units all fell within the fluvial portion of the Upper Wilcox, known as the Massive or Carrizo member in the literature (Ayers & Lewis, 1985; Breyer et al., 2001; Jeff P Crabaugh & Elsik, 2014; Hargis, 1984; Yancey, Dunham, & Durney, 2013). The outcrops display a range of depositional environments from swampy regions that preserved coals, to high energy channels that preserved erosive dunes. Descriptions and interpretations of common facies studied in this work can be found in Figure 33 with associated images in Figure 34. The outcrops are challenging to place within the cross sections as there is 20 km between them. However, Yancey et al. (2013) conducted paleontology in my field area and concluded that the outcrops in my field area are near the base of the Upper Wilcox clastic wedge. Due to the outcrop location landward of A-A', the closest rocks in the cross section would be in Sequence 1 in Well 1A. The three outcrops are roughly along strike from one another with Sunshine in the west, Dogbark in the middle, and Tall Pines in the east.

Facies	Description	Interpretation
Coal	Fillsile and fine grained in texture. Dark brown to black in color. Consists largely of fossilized organic material. Sometimes contains small sandy channels within greater coaly matrix. Observed in outcrop up to 2m thick. (**Figure A**)	Plant debris incorporated into the coal accumulated in a low energy anoxic (stagnant in this case) environment of deposition. These coals owe their genesis to **swamp environments** existing laterally to sandier and higher energy fluvial channels.
Muds	Fissile and fine grained in texture. Light to dark brown/ grey in color. The material largely consists of fines along with the occasional presence of silt. Any observable bedding is parallel laminated. Mud packages in outcrop range between 30cm and 2m in thickness. (**Figures B & C**)	The energy needed to transport and preserve the mud facies is greater than that of coal, and less than that of the sandier facies. These energy regimes can be found adjacent to channels in the forms of interfluve-**overbank/splay** deposits as well as levee deposits.
Interbedded sands and muds	Fissile mud matrix with sandy horizons and individual sandy channel fills. This facies typically has higher sand content near the base of packages and fines up to almost completely muds at the top of packages. Sands are typically lenticular and sometimes have erosive bases and parallel lamination. Sand size ranges between very fine- lower and silt. Individual sand units range between 13-1cm. (**Figure D**)	This facies represents a hybrid of depositional environments between overbank muds and the various cross bedded fluvial sandstones. These interbedded sands and muds represent a higher energy system than just muds, and lower than mud-free cross bedded sandstones. This environment either was lower energy, or had a sediment supply that was dominated by muds instead of sands. The enviornment would have been a **coastal marsh/swamp**, possibly laterally distal to a stronger fluvial axis.
Structureless to slightly parallel laminated SS	Well cemented and ranges between very-fine-upper to medium-lower in grain size. There were no observable bedding patterns to measure. However, at a distance a very fine lamination appeared to be present in the otherwise structureless sand. No sets were measureable, but whole packages ranged in thickness between 45cm and 2m. (**Figure E**)	Although the structureless nature of this deposit makes it hard to determine exact characteristcs of the depositing flow, one thing is certain, the **fluvial system** (maybe **braided**) that deposited this facies had a large sandy sediment load. The massive sand's featureless nature can be attributed to loss of forset lamination, liquefaction, or by massive supply in flood stage (Jones & Rust, 1983).
Cross bedded SS	Well cemented sands ranging between fine-lower to medium-upper grain size. Erosive cross bedding present, incising overriding packages into lower ones. Individual sets range between 10 and 60cm while whole packages get up to 5m. (**Figures F & G**)	**High energy fluvial systems** deposited this facies. The cross beds are the result of fluvial dunes scouring and depositing material as they moved downstream. These channels could have been bedload but more likely were mixed load meandering systems.
Sandstone with mudclasts	Well cemented sands, cross bedded or structureless to slightly parallel laminated, containing mud clasts. Clast features range from angular to rounded and between 0.5cm and 25cm. Clasts either congregate at the base of a unit, or are distributed throughout the matrix of a unit. Sometimes both. Thicknesses range between 20cm and 2m. (**Figures E & H**)	This facies was deposited in very similar **high energy fluvial** conditions to the cross bedded sandstone facies. This facies either had higher energy, or was incising into a muddier strata to produce the mud clasts. The clasts derive from channel banks eroding into muds and the resulting mud-bank clasts falling into the flow and being incorporated and subsequently deposited. Angular clasts indicate rapid deposition, while rounded clasts indicate some distance of transport from the erosive site prior to deposition.
Cracked and cemented SS	Well cemented and then re-cemented sandstone. These sands underwent strong diagenetic processes post deposition resulting in the observed pattern. Grain size ranges from medium-lower to fine-upper. Thicknesses range from 30cm to 1.5m. The diagenetic filling pentrates up to 3 inches deep and 6 inches across when observed. (**Figure I**)	Although the post depositional alternations remove many of the indicators of depositional environment, it is safe to say that these sands were deposited in **high energy fluvial** setting based on their proximity to surrounding facies and entrained mud clasts. This facies is useful in that through grain size analysis relative energy of deposition can be determined in respect to those surrounding beds.

Figure 33: A table delineating facies encountered in the field and their associated interpretations. See Figure 34 for corresponding photos.

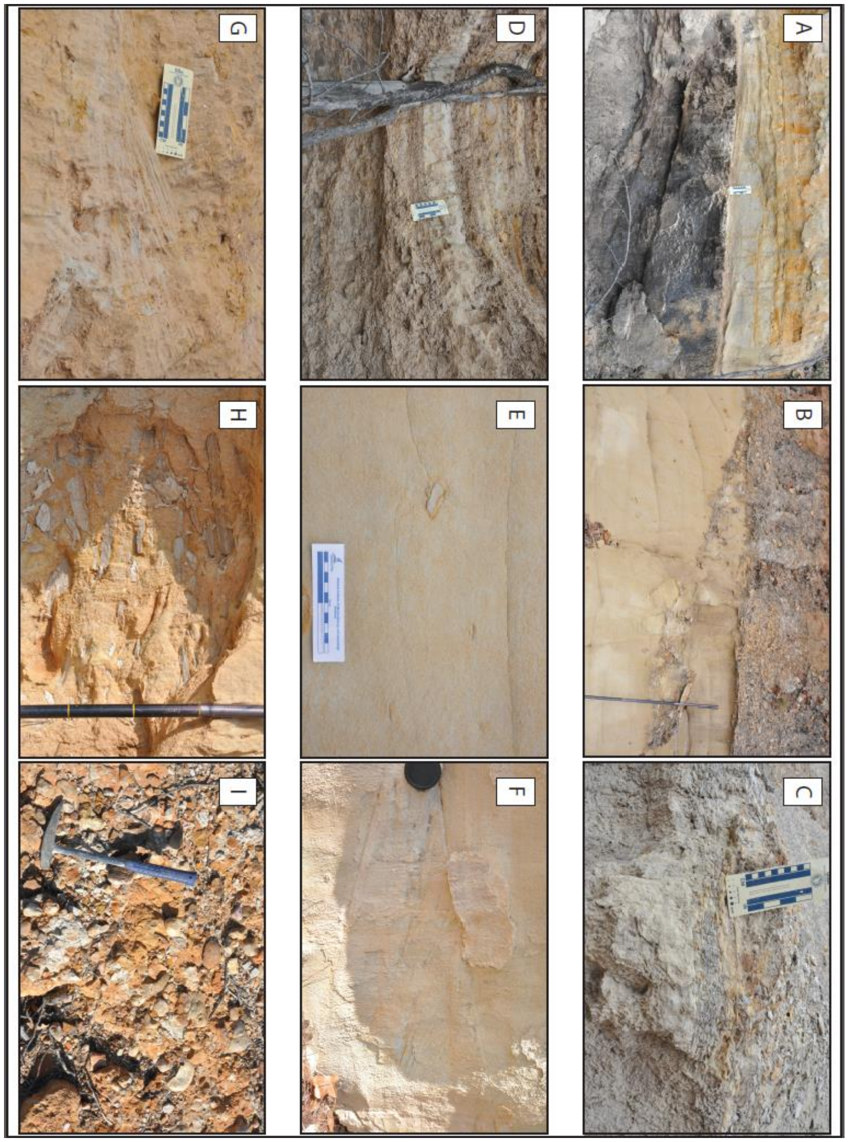


Figure 34: Photos of the facies observed in the field and described in Figure 33. For detailed descriptions of each facies see Figure 33. A shows coal beds that overriding fluvial sands erode into. B shows some of the overbank muds that were incised into, as well as a layer of entrained mudclasts as the base of a channel. C shows a unit of finer mud in between two sandy channel bodies. D shows lenticular sands isolated and incising into the surrounding finer mud facies. E shows structureless sands that appeared with regularity. F shows a set of cross beds truncated by an overriding set of crossbeds. G shows classic swooping cross beds. H Displays some of the larger mudclasts entrained in the sandy channel bodies. I shows the mottled/altered sands at the tops of some of the outcrops.

Tall Pines

This outcrop runs around 20 m horizontally and up to 8 m vertically. A majority (~90%) of the outcrop consists of fine to medium grained sandstone making up a series of lenticular bodies eroding into one another. Around 60% of the displayed surface shows trough cross bedding. Where there are no cross beds present, structureless sandstone makes up most of the rest of the outcrop. Muds make up the rest of the depositional facies in the outcrop and are only present as one unit in the left of the image. Mudclasts, ranging from 0.5 cm to 25 cm, are present in both the cross bedded units as well as in the structureless units. Paleocurrent values at this location show a strong north to south trend with an azimuth range between 45-215°.

The thickest unit in the Tall Pines outcrop is two meters thick consisting of trough cross bed sets, reaching up to 60 cm thick some 5m up in the third section. Aside from the truncated bedforms that indicate the erosive power of these flows, the entrained mudclasts also point to this being an erosive system. Mudclasts were eroded from the muddy substrate (which is preserved in the lower left of the figure) or the banks that these flows were incising through (see the base of section 1 and Figure 34.B). The mudclasts in the sandstone overriding the muddy interval have the same composition as the muds that make up the substrate being eroded into. Mudclasts in the Tall Pines outcrop reach up to 30 cm (Figure 34.H) suggesting strong flows, possibly flood stage events leading to entrainment and subsequent deposition. Structureless beds in the Tall Pines outcrop (Figure 34.E) represent deposition in periods of increased sediment flow that inhibited normal bed formation.

The only muddy interval in the outcrop is present in the left of the photo, seen near the base of section 1 (Figures 35 and 34.B). These muds were deposited in a lower energy environment than that of the surrounding sands. There were undoubtedly more muddy intervals with thickness in the meters (as is observed in the subsurface), but the present sands eroded much of these muds transporting them further into the basin.

The erosive nature of the distinct sandstone units with trough cross bedding, unidirectional paleocurrent directions, and lack of marine bioturbation or influence suggest that this outcrop was deposited by an alluvial fluvial system, possibly in the alluvial plain or upper coastal plain of Sequence 1, landward of Well 1A.

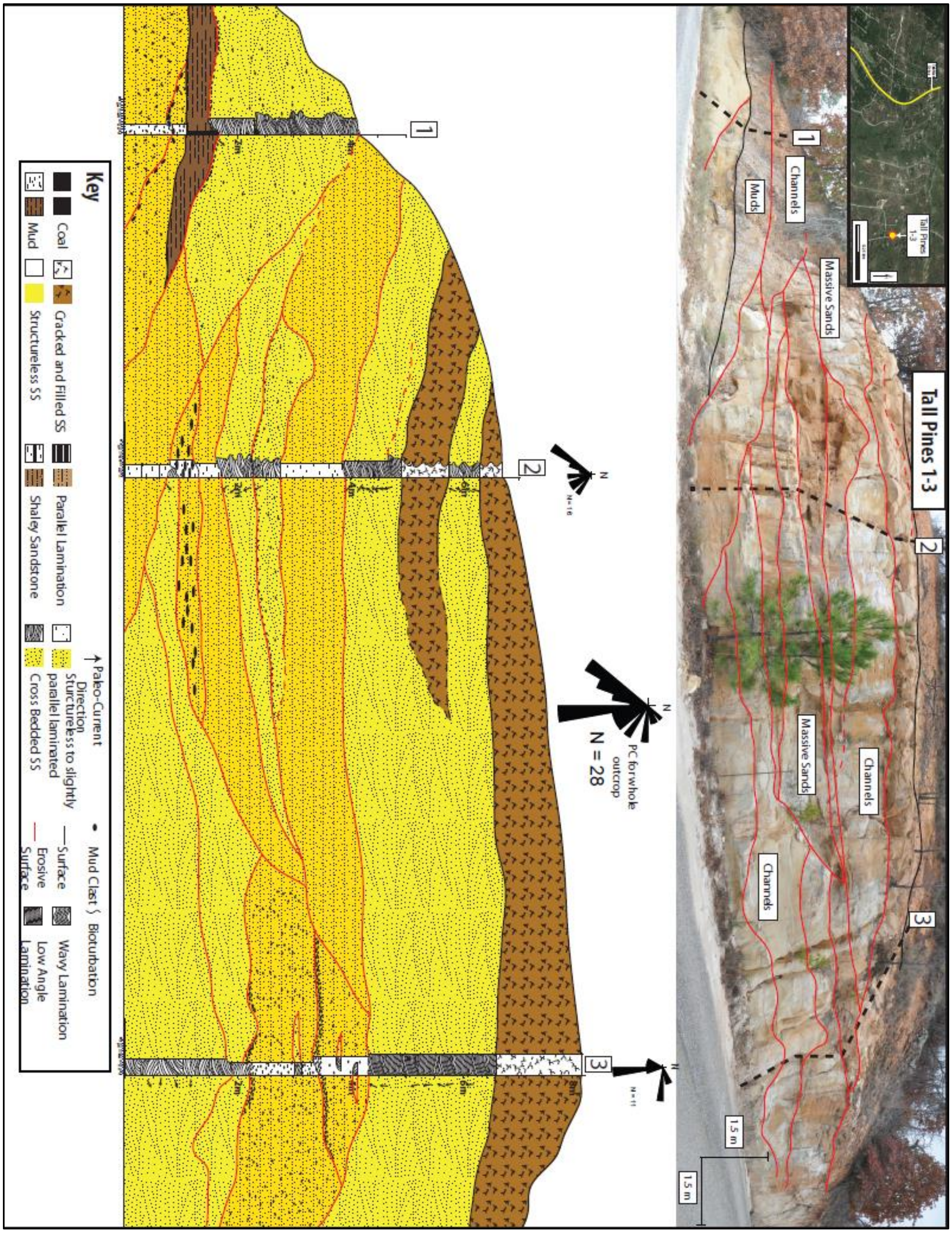


Figure 35: Tall Pines outcrop. Three measured sections generally showing trough cross bedding.

Sunshine Outcrop

This outcrop spans 30 meters horizontally and 5-7m vertically. The exposure is dominated (>90%) by trough cross-bedded sandstones (Figure 36). The sand ranges in size between medium and fine-grained units, generally showing an upward-fining pattern when grain sizes changed within the same erosive unit. Only a small fraction of the exposure, a muddy interval in the bottom left of Figure 3.29, differs from the pervasive sandy units. These muds represent the substrate that was lateral to and then incised into by the sandier units. A few mudclasts are present, mostly along the base of channel 3 in sections 1 and 2, and at the base of channel 4 in section 2 (Figure 36). The mudclasts range in size from 0.5cm to 3cm. Paleocurrent values show a south-southeast trend with a range between 110-240°.

Dominantly erosive trough cross beds, unidirectional paleoflow, and lack of any marine influences or bioturbation indicate that the strata of this outcrop was deposited by an alluvial fluvial system. The lenticular incising channels present highlight the erosive nature of this system. Sunshine outcrop is relatively straightforward, with four distinct channel packages made up of trough bed sets of varying thicknesses. Channel one, stretching between both sides of the outcrop shows that the depositional river would have been at least 30m wide. Channel 3's truncation by channel 4 is the only pinching out relationship observed in this outcrop. Both Sequences 1 and 3 have strong fluvial components (Figure 28.A and 30.A) predicted where these outcrops lie. Combined with Yancey (2013) work, these fluvial systems were probably deposited in Sequence 1 or Sequence 3.

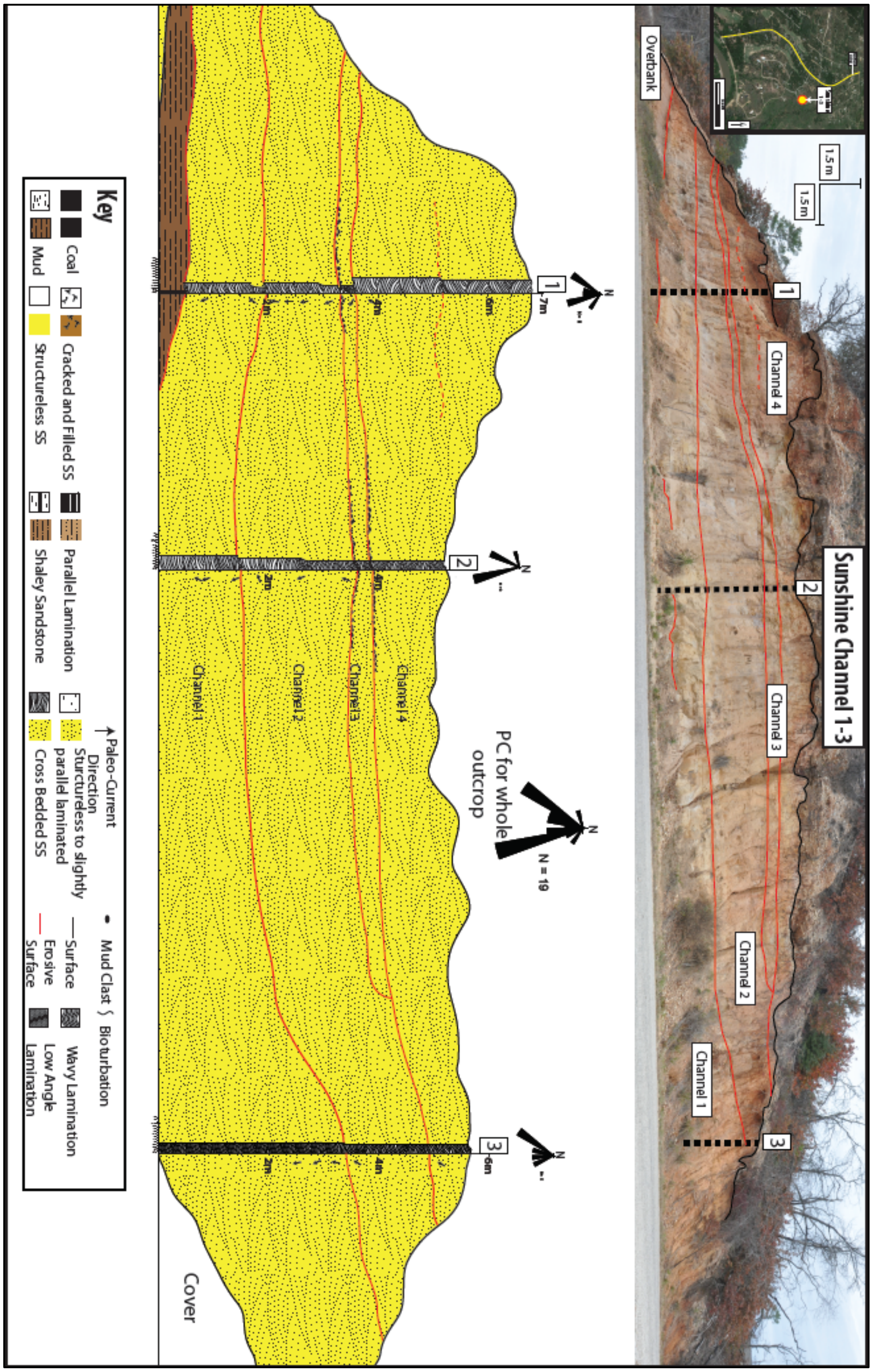


Figure 36: Sunshine Channel outcrop. Three measured sections showing omnipresent trough cross bedding.

Dog Bark Outcrop

This outcrop runs over 100 meters horizontally (extending 70m to the right of what is pictured in Figure 37) and over 20m vertically making it the largest studied outcrop in this thesis. The near vertical nature of the outcrop made continuous sections hard to record which resulted in only two full measured sections. This outcrop shows more variation in facies than both Tall Pines and Sunshine outcrops. Dog Bark has more mud and fine facies contained in the exposure than the other two outcrops. Just over half of the units are made up of sandy beds that show trough cross bedding, and structureless units. The coarser facies range between fine and medium-grained sandstones.

The mud facies seen above 10m in section one and above 8m in section two has interspersed silty beds and light bioturbation (seen in Figure 34.C). The next unit up consists of a muddy matrix with dispersed fine sand bodies. These lenticular sand units fine and thin upward in the facies, until they cease to exist for around meter at the top of the facies. Coal is found at the base of the outcrop in section 2. The coal is fissile and rich with organic matter and terrestrial fossilized plant material. There are two lenticular sand channels present in the coal matrix. Mudclasts up to 15cm but more commonly 2cm were observed near the top of section 1, at the base of an erosive sand unit around 19m. Paleocurrent measurements show a strong northeast to southwest direction of flow. These flow directions correspond to fluvial axis presented in Sequences 2-4 in section 3.2 of this thesis, combined with the strong fluvial presence of Sequence 2 (Figure 29.D) this outcrop was probably deposited by Sequence 2.

The trough cross bedding and coal beds in this outcrop indicate that these sediments were deposited in a fluvial or coastal/delta plain environment. The coals were deposited in very low energy environments lateral to active fluvial channels. These swampy regions occasionally had faster moving channels traversing them as is shown by the two sandy channels. The prevalence of finer units in Dog Bark outcrop indicates that this location experienced more periods of quiescence than the other outcrops due to natural fluvial migration patterns. Another explanation for the increased fines is that their presence is the result of differential erosion in the modern. The mudclasts are evidence of a channel incising through a muddy substrate much like the units found lower in the sections. Sequences 1 and 3 predict rivers to flow through this studied region and therefore were probably responsible for the deposition of this outcrop.

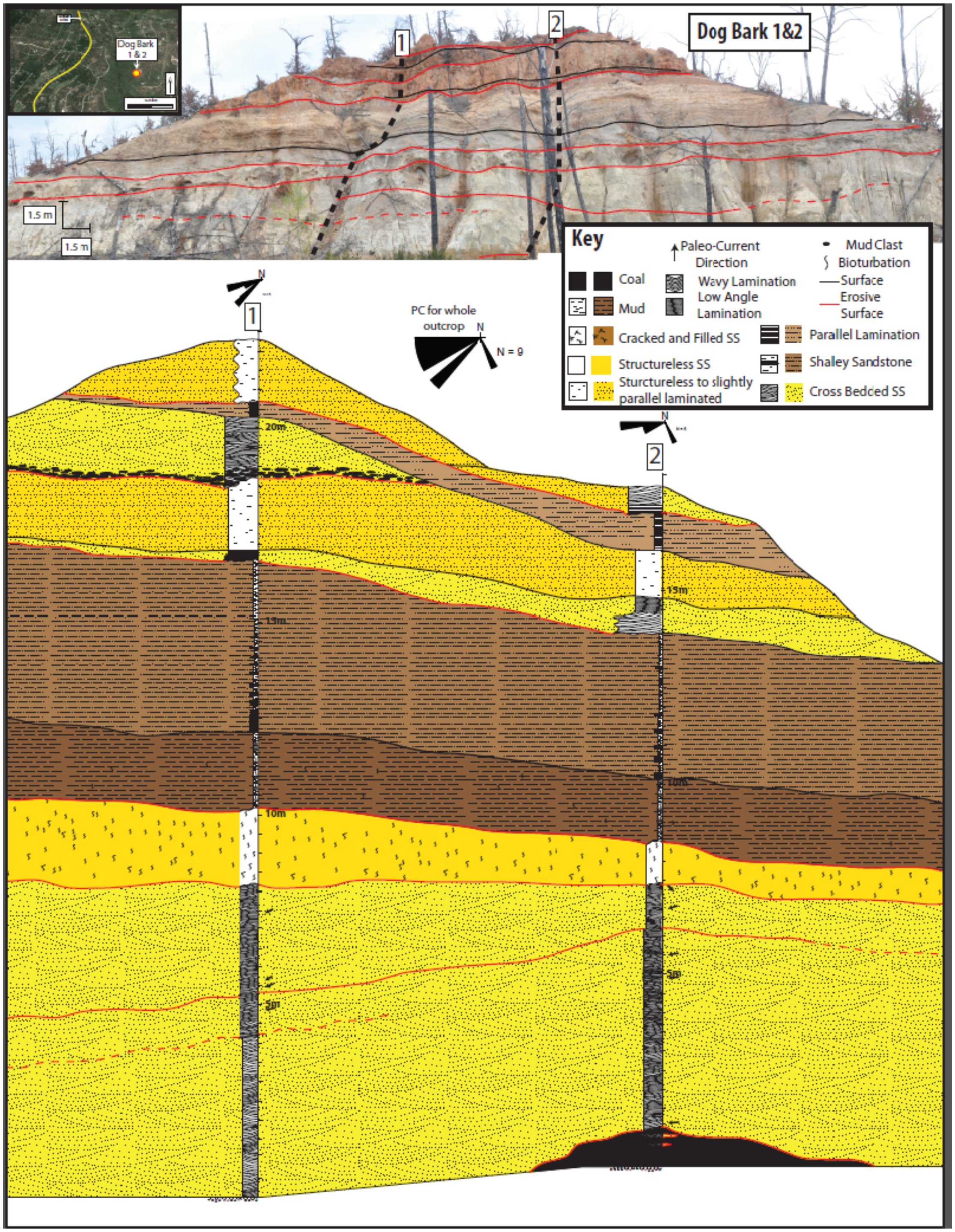


Figure 37: Dog Bark outcrop. Two measured sections showing a variety of depositional environments. The only coal in this study's outcrop is observed at the base of section 2.

CALCULATED VOLUMES AND CHANNEL DIMENSIONS

Channel calculations for the three outcrops were executed following the steps articulated in the Methods section of this thesis. Average values for each outcrop are presented here, for a full accounting of measurements and calculations please see the appendix. The average bankfull depth (D) for all measured sections was 3.01m and the average bankfull width (W) was estimated to 108.28m. This resulted in a Width/Depth ratio (F) of 34.37. These values allowed for a variety of calculations, the most important being a rough estimate of the sediment load (Qs) of the studied channels. Qs for the average channel came to 164 kg/s, or 5.72*106t/yr. These values are subject to large margins of error and therefore are not an attempt to exactly record the sediment load transported by these systems. Instead, these values act as a starting point for estimating the size of the load that was being fed into the basin through the Houston Embayment. These values also serve as a tool to help delineate what volumes of sediment the Yoakum Canyon may have been able to transport while it was still behaving as a bypass system to the deepwater.

There are two sources of 25% error early in the calculations. The 25% error in measurement of cross sets in the field assume an over-estimation in Eq. 1, therefore this error will only be subtracted from the calculated values. Conversely, the error in Eq. 2 derives from natural variances in the analogs used to develop the equation, and will therefore act as a ±25% of error on the calculated values (Holbrook & Wanas, 2014; Holbrook, 2001; Leclair & Bridge, 2001). This means that the final resulting Qs value needs to be amended by -50% and +25%. Using a factor of -0.5 and +0.25 the resulting Qs results are 82.5-205 kg/s or 2.86-7.15*10^6t/yr. These values have such a spread that their functionality in mass-balance type equations would be limited. Rather, these values act as a starting point for future and comparative evaluation.

Ideally the D value would derive from direct measurements of a cross section of channel in the field (Bridge & Tye, 2000). No complete channels were available for analysis in the Bastrop field area due to repeated incision of overriding channels which led to the use of Equations 2&3 for estimation. However, the preserved channel thickness that is observed provides a lower limit on what depths the channels achieved. The thickest measured channel deposit was around 4.5m thick in section two of the Dog Bark outcrop (Figure 37). Most of the preserved channel deposits fell between 0.7m and 2.5m. To compensate for compaction, the thicknesses are expanded by 10% resulting in thicknesses of 0.77 and 2.75m (Ethridge & Schumm, 1977; Holbrook & Wanas, 2014). These values agree with and are within the same order of scale to the calculated average value of 3.01m channel depths (Figure 3.4).

Variable and Equation	Tall Pines Average	Sunshine Average	Dog Bark Average	Total Average
Average Cross Set Height (cm) (S_m) (Eq. 1)	24.35	28.95	27.14	26.82
Estimated Dune Height (cm) (h_m) (Eq. 2)	70.62	83.97	78.71	77.77
Paleoflow Depth (m) (D) (Eq. 3)	2.79	3.23	3.02	3.01
Width Estimate (m) (W) (Eq. 3)	94.29	118.10	112.43	108.28
Width/Depth ratio (F) (Eq. 4)	33.19	35.89	34.04	34.37
Sinuosity (P) (Eq. 5)	3.61	3.68	3.62	3.64
Mean Annual Discharge (cms) (Q_m) (Eq. 6)	70.79	113.95	133.47	106.07
Mean Annual Flood (cms) (Q_{ma}) (Eq. 7)	1907.20	2573.75	99.38	1526.78
Channel Slope (S) (m/km) (Eq. 8)	11.18	9.72	11.73	10.87
Meander wavelength (L) (m) (Eq. 9)	2655.07	3232.03	3045.75	2977.62
Sediment Load (Q_s) (kg/s) (Eq. 10) (R=3km)	137.51	170.35	182.91	164.95
Sediment Load (10^6 kg/yr) (R=3km)	4.77	5.91	6.35	5.72
Lower Error Bound *(0.5)	2.39	2.96	3.17	2.86
Upper Error Bound *(1.25)	5.96	7.39	7.93	7.15

Figure 38: Equation names and values based on outcrop measurements used to determine paleoflow characteristics of the fluvial systems feeding the Upper Wilcox. The calculated sediment load is presented in yellow.

Discussion

This is the first study to break down the Upper Wilcox clastic wedge into five constituent sequences. Breaking the Upper Wilcox clastic wedge into five depositional sequences that have some significance for cross-shelf transits of the delivery system, allows for the determination that the regressive shorelines sequentially prograded further through time (Figure 39) and each was followed by some transgression.

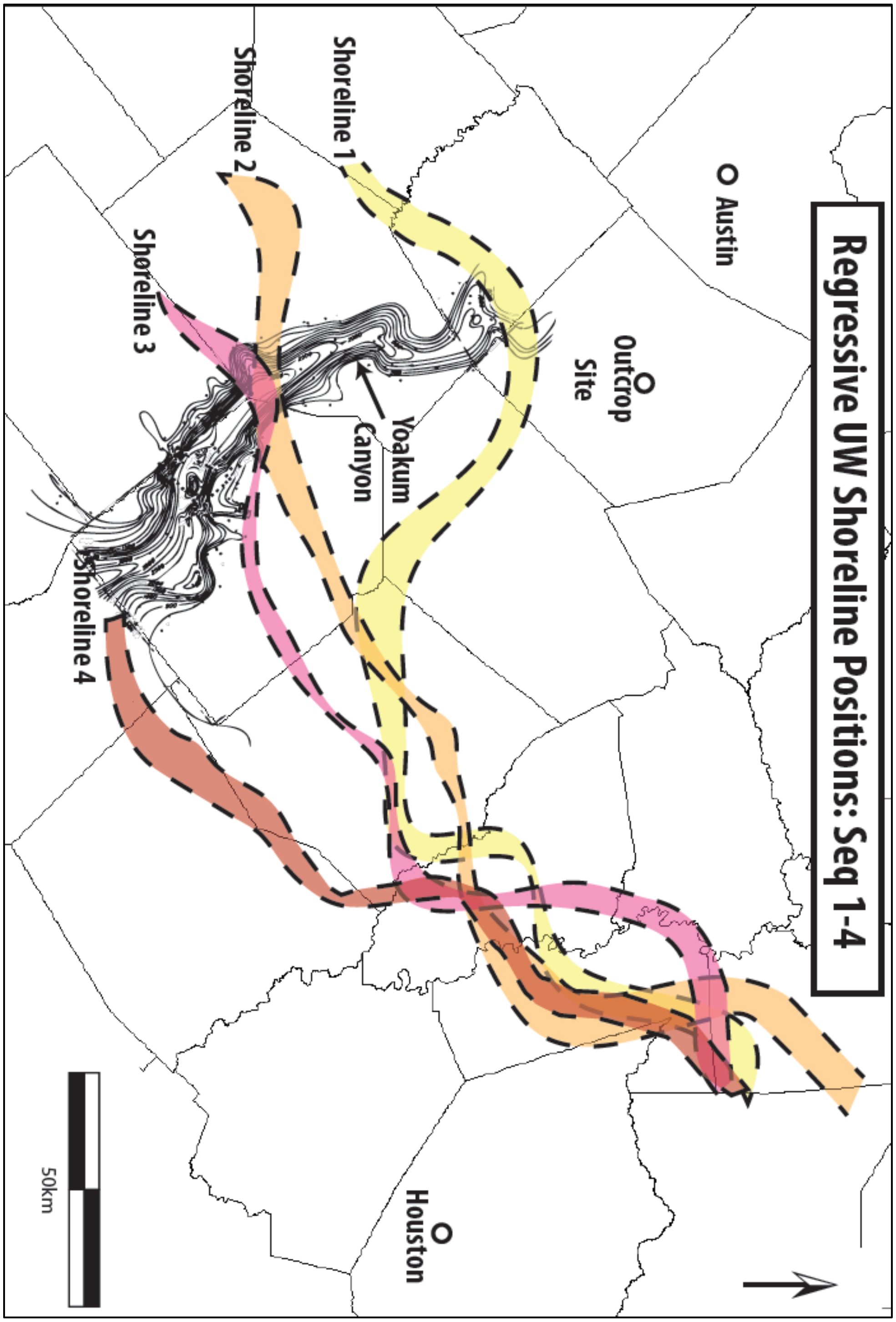


Figure 39: Regressive shorelines for Sequences 1-4 of the Upper Wilcox clastic wedge in the Houston Embayment. The "swinging" of the shoreline across the Yoakum Canyon region is evident here.

DEPOSITIONAL SYSTEMS OF THE UPPER WILCOX

Measurements from Upper Wilcox outcrop above the Yoakum Canyon suggest that the fluvial systems emerging from the headward reaches of the canyon would have been carrying sediment loads between 2.86-7.15*10^6t/yr, this is smaller than the size of the modern Brazos river (16*10^6T/yr), however there is little chance that the measured outcrops represent the largest fluvial bodies of the Upper Wilcox in the Houston Embayment (Milliman & Syvitski, 1992). This sediment would have had the potential to bypass for millions of years prior to the Yoakum Canyon shutting down as a conduit to the deepwater. Although Zarra (2007) and others have identified most of the proven reservoirs to originate in Lower Wilcox time, the trend is so vast that the Upper Wilcox sediments could have contributed significantly to as yet undiscovered regions.

Deltas in the Houston Embayment in Lower Wilcox time have been characterized by their wave dominated/ strike elongate features (Fisher & McGowen, 1967; Galloway et al., 1991; Winker, 1982). The Middle Wilcox in the Houston embayment was described as having a "dip-dominated sandstone trend" (Xue & Galloway, 1995) which is here interpreted to not have been a wave dominated delta. The Upper Wilcox is commonly referred to as being a wave dominated delta, when in fact, it is only wave dominated in the Rio Grande Embayment (Edwards, 1981; William E Galloway et al., 2000; Miller, 1989). In the study area there are large (tens of kms) transgressions and regressions which extended the fluvial system during maximum regression periods and built <80m m thick fluvial and alluvial coastal plain deposits (Figure. 23-25) with relative narrow fronting shoreface/delta deposit belts. The transgressive deposits were relatively thin (<10 m) and capped the alluvial (regressive) deposits. Previous large scale studies of

Galloway et al., (2000) describe the large fluvial system without emphasizing the shoreline deposits. A large fluvial system with thin shorelines suggests (1) a significant accommodation (subsidence?) across a relatively steep alluvial plain in which case limited amounts of sand reached the shoreline, or (2) the fluvial derived sand was not accumulating in the shoreline but was by-passing the system, in this case via Yoakum Canyon, to deep water. Beyond the shorelines fluvial-dominated deltas were identified and mapped, agreeing with Galloway et al. (2000) description of the sediments that did extend beyond the shoreline.

TRANSGRESSION-REGRESSION SEQUENCES OF THE UPPER WILCOX IN THE HOUSTON EMBAYMENT AREA

This study is the first to identify a highly embayed regressive shoreline in Sequence 1 that continued in sequences 2 and 3 over the inner part of the Yoakum Canyon. During the Upper Wilcox time, the regressive shorelines advanced 117 km in the southwest of the field, and 18 km in the northeast (Figure 39). Each regression was followed by a subsequent transgression (average transgressed distance of 30 km) with associated bayline (transgressive shoreline) (Figures 39, 40, and 41). This observed pattern of progradation followed by transgression at the top of the sequence that does not extend as far updip as the underlying transgression was proposed by the concept work on genetic stratigraphic sequences model (Galloway, 1989), though he did not demonstrate this for the Wilcox high-frequency sequences. The Upper Wilcox's first two sequences had regions where the bayline was pinned in the same location where the regressive shoreline existed below (Figures 39, 40, and 41). The stable shorelines during transgression can be explained by locally high sediment supply to that particular area along the shoreline (Figure 21) and is reinforced by the presented sand thickness/ fairway maps (Figures 28.A, 29.A, and 30.A). Alternatively, is possible that following previous regression of deltas, the coastal plain had higher gradients that slowed the transgression (Figure 21).

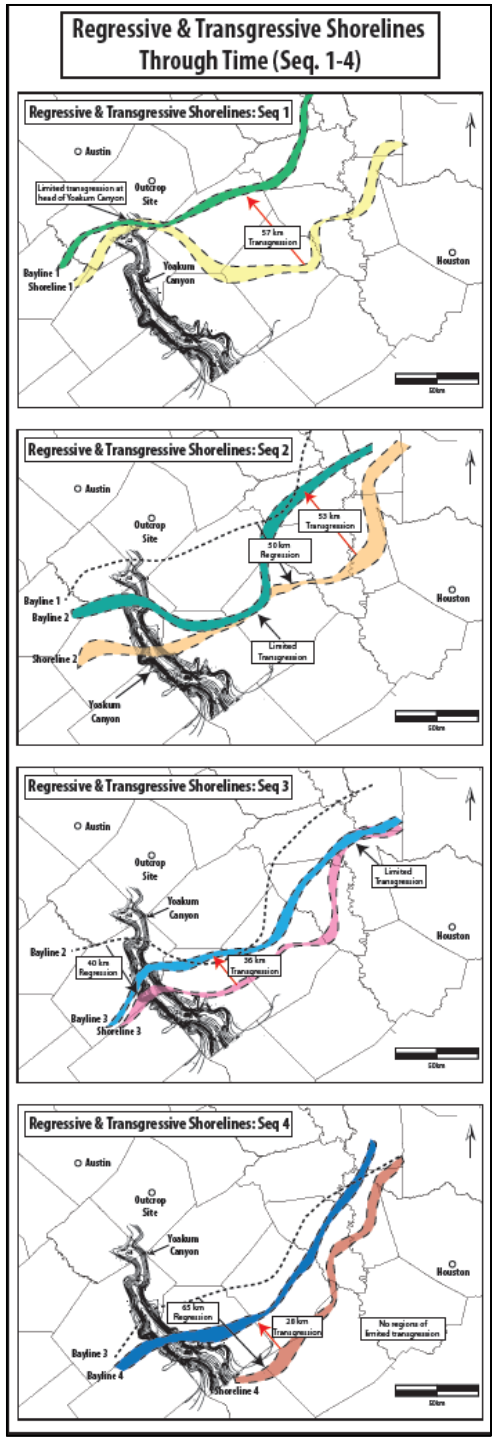


Figure 40: Regressive and Transgressive shoreline pairs for Sequences 1-4. The linear nature of the shorelines improves through time corresponding to the filling of the Yoakum Canyon.

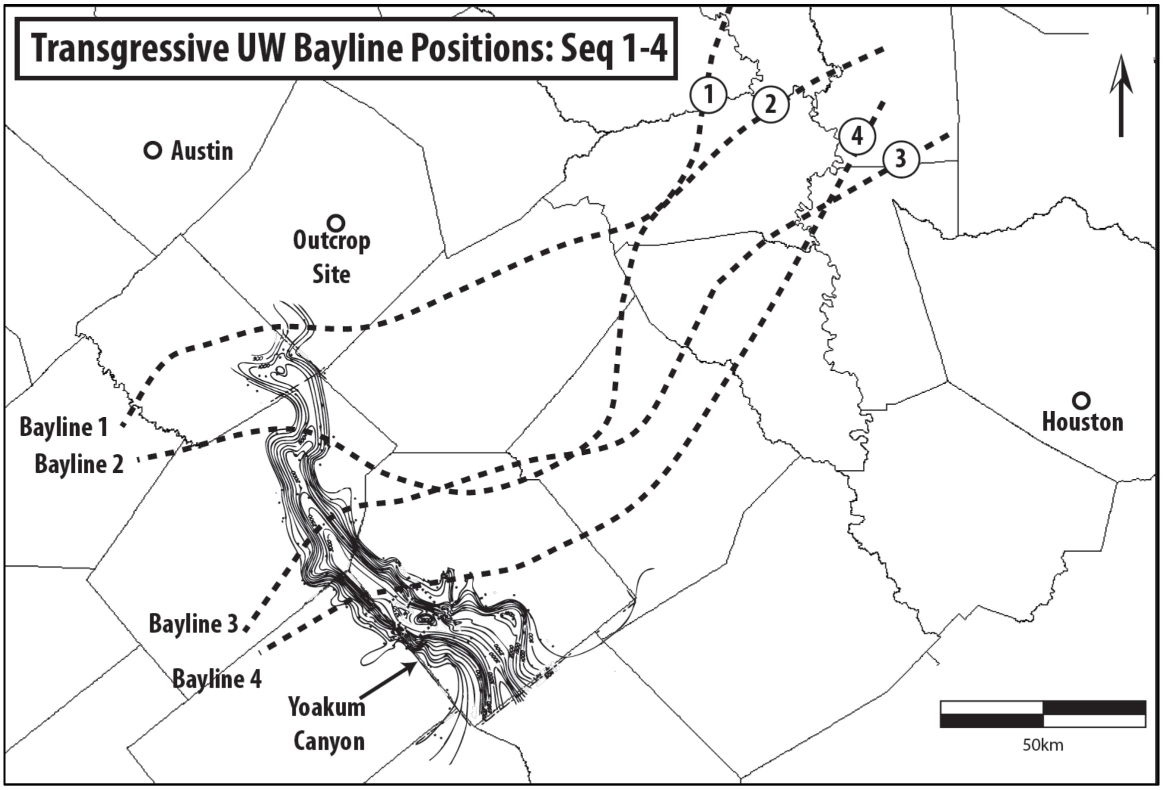


Figure 41: Locations of the four transgressive shorelines (Baylines) in the Houston Embayment during the Upper Wilcox. Note that the maximum transgression shorelines move basinward through time, similar to the maximum regression shorelines.

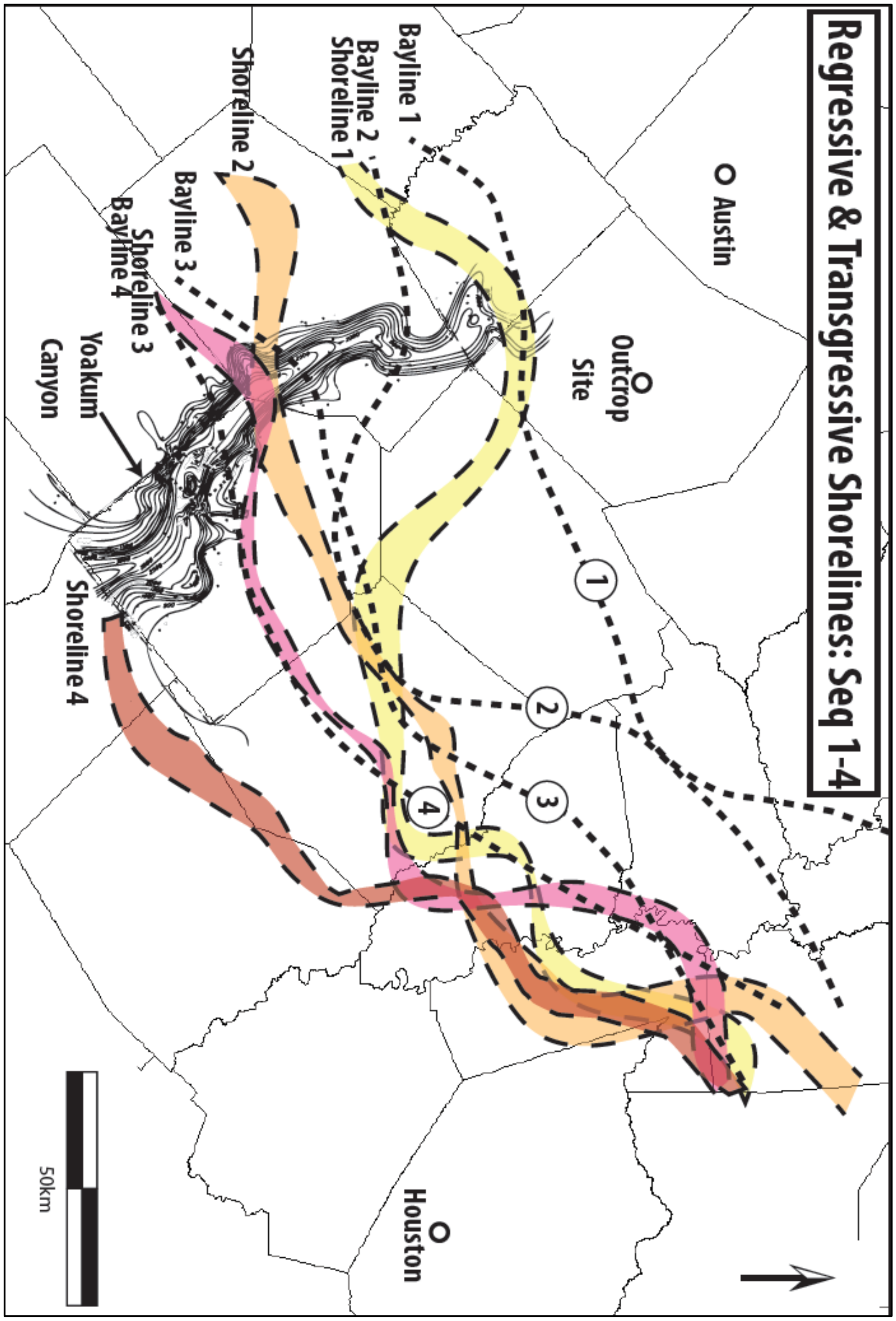


Figure 42: Locations of regressive and transgressive shoreline through Sequences 1-4. Their locations in respect to the Yoakum Canyon show a strong progradational pattern through time.

Previous work has only considered the Upper Wilcox as a single clastic wedge. Miller (1989) provided some of the most detailed interpretations (Figure 9). This work finds fluvial axes corresponding to Miller's Jewett Fluvial System in the lower sequences and then a dominant fluvial system corresponding to Miller's Western axis through Sequences 3 and 4. The Columbus Delta in Miller's work has three distinct lobes (Figure 9), this work shows three lobes, but only two of which are present through Sequences 1-4 (Figures 28-31, and 39-42), but the western-most lobe disappears after Sequence 3. Miller's work has a slight indent of the shoreline over the Yoakum Canyon region (Figure 9), possibly reflecting the strong embayment in Sequence 1 shown in this work (Figures 28 and 39). McDonnel et al. (2008) shows a Gulf of Mexico-wide depiction of the Upper Wilcox time (Figure 8). The Houston Embayment in her work is divided almost equally between the following depositional systems: wave-dominated delta, fluvial-dominated delta, fluvial, and bedload fluvial (Figure 8). Instead of describing the Upper Wilcox over the Yoakum Canyon region, where this study shows prevalent indentation of the lower shorelines (Figures 28-30 and 39-42), McDonnel et al. (2008) shows the underlying canyon and no shoreline position information (Figure 8). Galloway et al. (2011) displays a continental-wide depiction of the Upper Wilcox geology (Figure 5). Within the Houston Embayment there are four basin elements: depositional coastal plain, fluvial axes, deltaic depocenters, and a maximum progradational shoreline (Figure 5). The fluvial axis does split into two distinct branches (Figure 5), an occurrence that is observed in Sequences 1-3 of this study (Figures 28-30). The presented shoreline runs almost straight through the Houston Embayment in Galloway et al. (2011), whereas this study shoes that the shoreline was dynamic between sequences and moved up to 100 km during the Upper Wilcox time (Figures 39-42). Each of these previous studies shows depositional elements that the current study also identifies. However, each of the past studies is hampered by the fact that they approach the Upper Wilcox as a single unit. This study, in breaking the Upper Wilcox into its five constituent sequences, allows for a much finer level of detail in identifying the depositional features of each sequence within the field area.

UPPER WILCOX SHORELINE IN RELATION TO THE YOAKUM CANYON

The present model for Yoakum Canyon fill (Dingus & Galloway, 1990; Dingus, 1987) show that Yoakum Canyon was filled during middle Wilcox time and the Upper Wilcox prograded over its fill. The evolution of the shoreline mapped in this project suggests that Yoakum Canyon was under-filled and interacted with initial shorelines of the upper Wilcox (Figures 39, 40 and 42). If the Yoakum Canyon was incompletely filled at the time of upper Wilcox (seen in Figure 39) it means it provided a viable conduit for sediment to bypass the shelf and slope systems into the deepwater for a longer time, not only the Middle Wilcox but at least Sequence 1 of Upper Wilcox (Figures 3.2.1.3 and 39) as well. These conditions were also partially present for Sequences 2 and 3, but the Upper Wilcox shoreline had prograded and probably contributed sediments to fill tens of kilometers of the canyon after Sequence 1, and may not have been as productive a bypass feature.

The morphology of the interpreted Yoakum Canyon and the Upper Wilcox regressive shorelines (Figures 3.2.1.3 and 39) is analogous to features observed in the Soquel Canyon in the modern on California's coast (Figure 43). The Soquel Canyon actively transports sand from the modern shoreline to the deepwater (Paull et al., 2005), with dimensions that extend 162 km into the basin and reach depths of 3495'. The Yoakum Canyon extended at least 108 km (before the canyon fill achieved depths beyond well control) and reached at least 3500' deep in places (Dingus, 1987; Dingus, 1990).

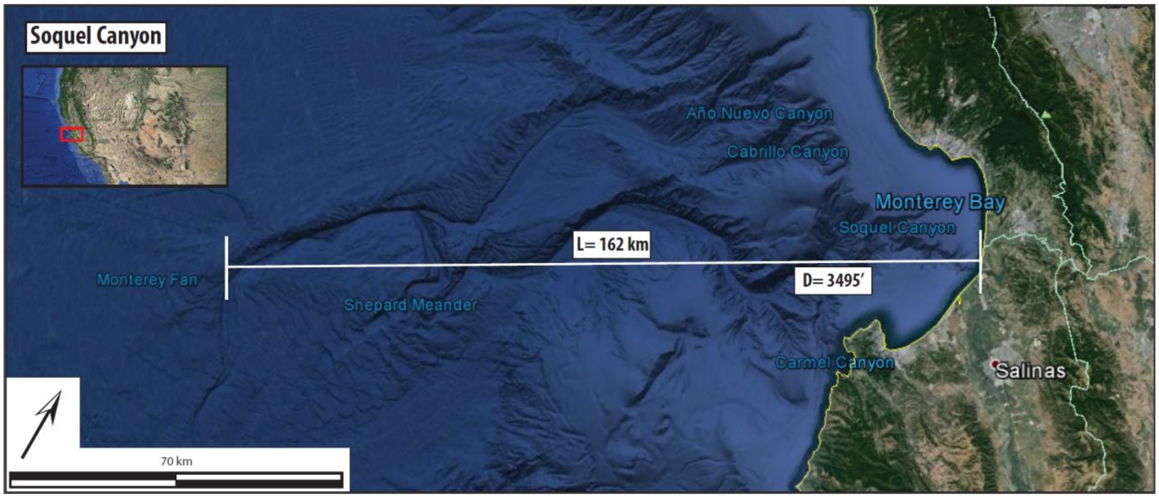


Figure 43: The Soquel Canyon, offshore California, USA. The canyon's dimensions are very similar to the Yoakum Canyon's. The Soquel Canyon also shows an embayed shoreline, similar to the interpreted shoreline in Sequence 1.

Conclusions

1. Well log correlations were used to divide the Upper Wilcox into five large constituent regressive-transgressive sequences (4th order sequences in some terminologies). The regressive deltas and transgressive estuaries that make up these sequences variably transited back and forth across the Gulf of Mexico shelf, and these sequence increments were the fundamental building blocks for aggradation and progradation of the GOM shelf-margin prism at this time.

2. Lateral variation in shoreline location through time shows a mainly aggradational shoreline development style over the region of the earlier sand-rich Lower Wilcox Deltas, and a dominantly progradation shoreline style over the region of the Yoakum Canyon.

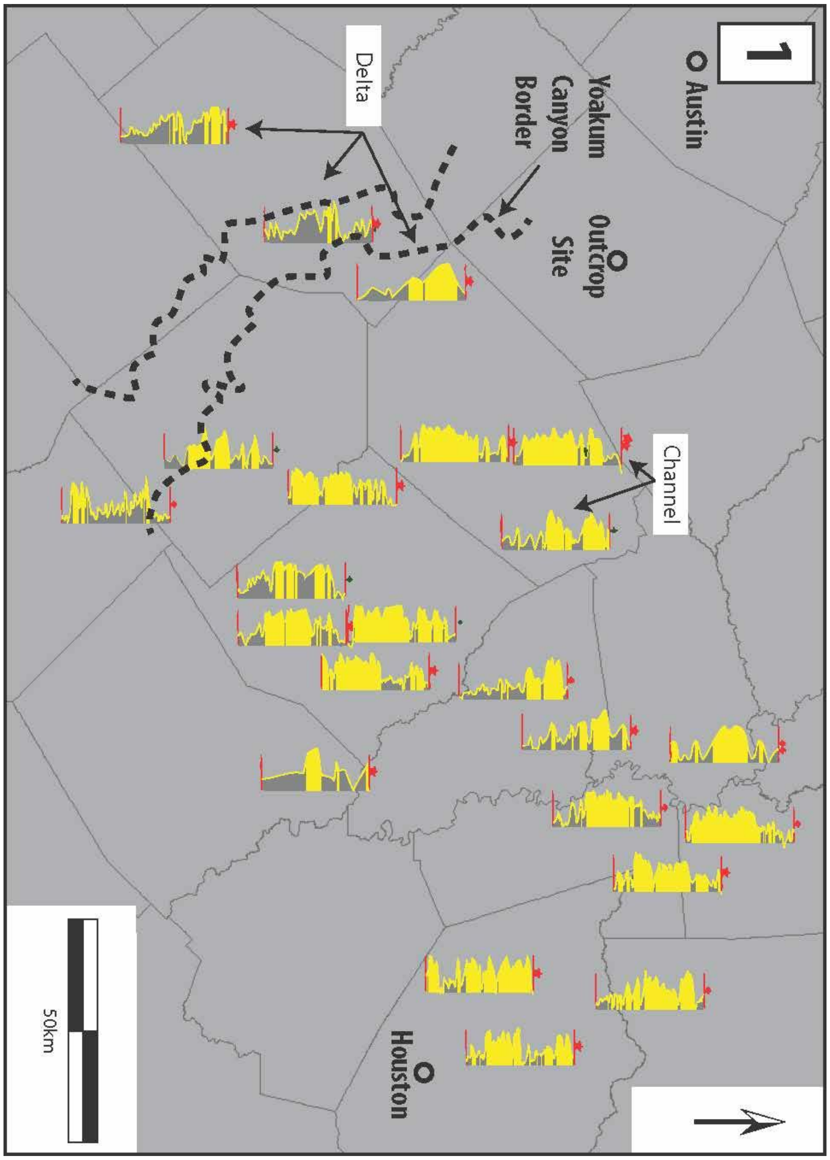
3. Based on well log signatures and interpreted depositional environments, the Yoakum Canyon had not been filled when the Upper Wilcox shorelines arrived in the embayment. This could have allowed the canyon to continue to act as a bypassing conduit for the sediment of the first Upper Wilcox sequences.

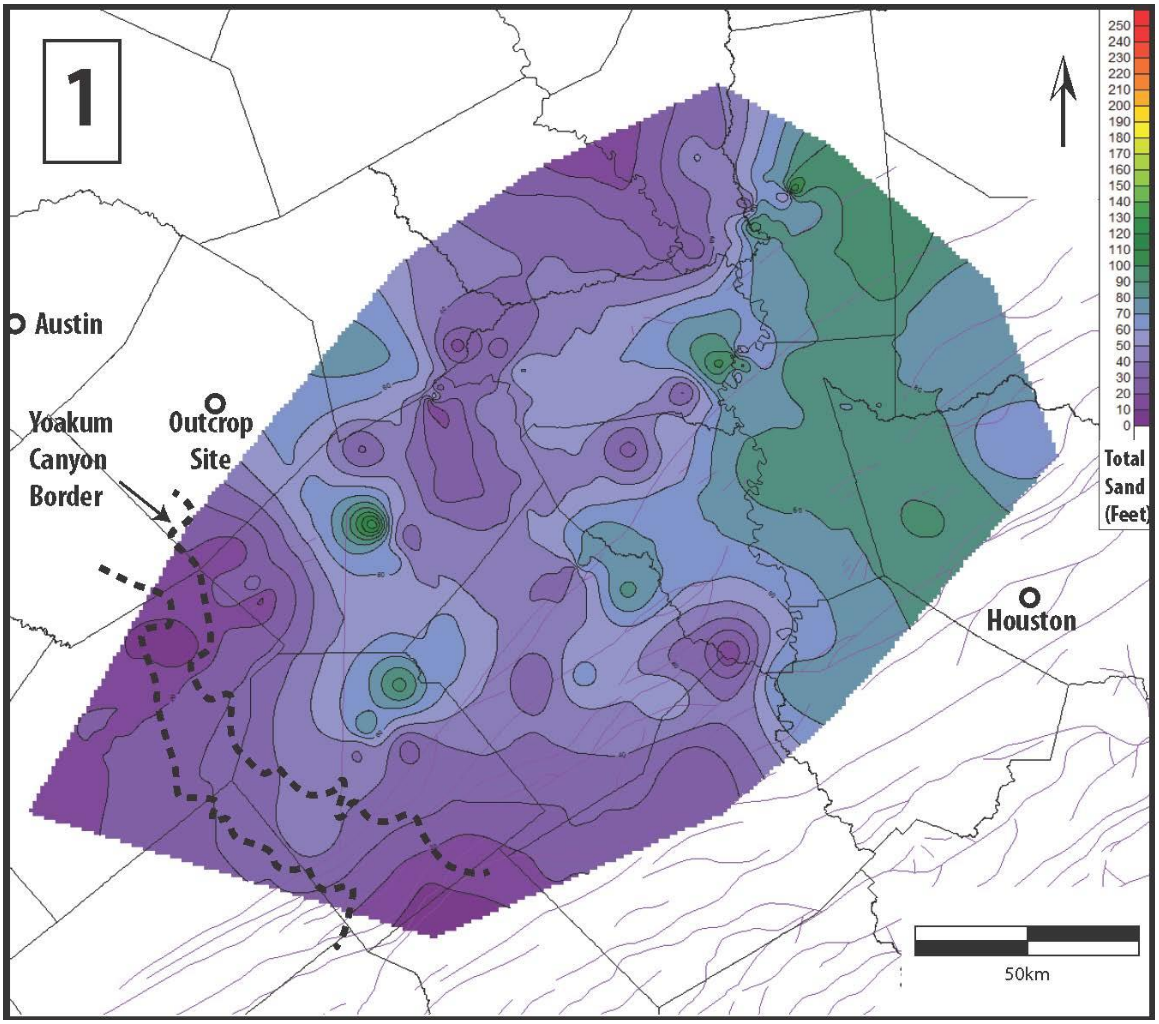
4. Unlike the more commonly described wave-dominated Upper Wilcox deltas in the Rio Grande Embayment, the Upper Wilcox deltas in the Houston Embayment were fluvial dominated deltas.

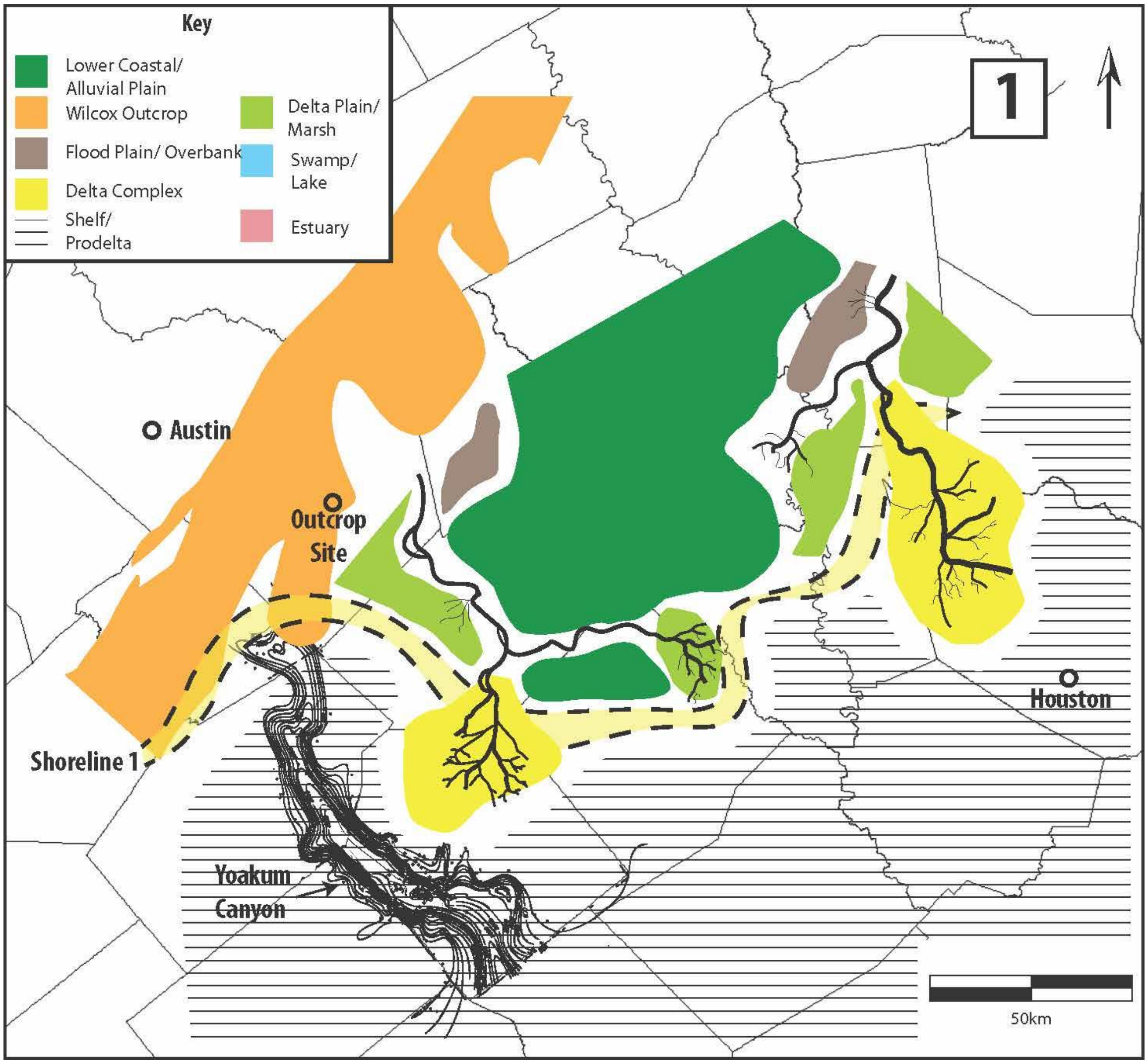
5. Outcrop measurement and associated calculations determine that the fluvial systems feeding the Upper Wilcox in the Houston Embayment could have been delivering up to $7.15*10^6$ t/yr. Some of which could have bypassed the shelf completely using the unfilled Yoakum Canyon.

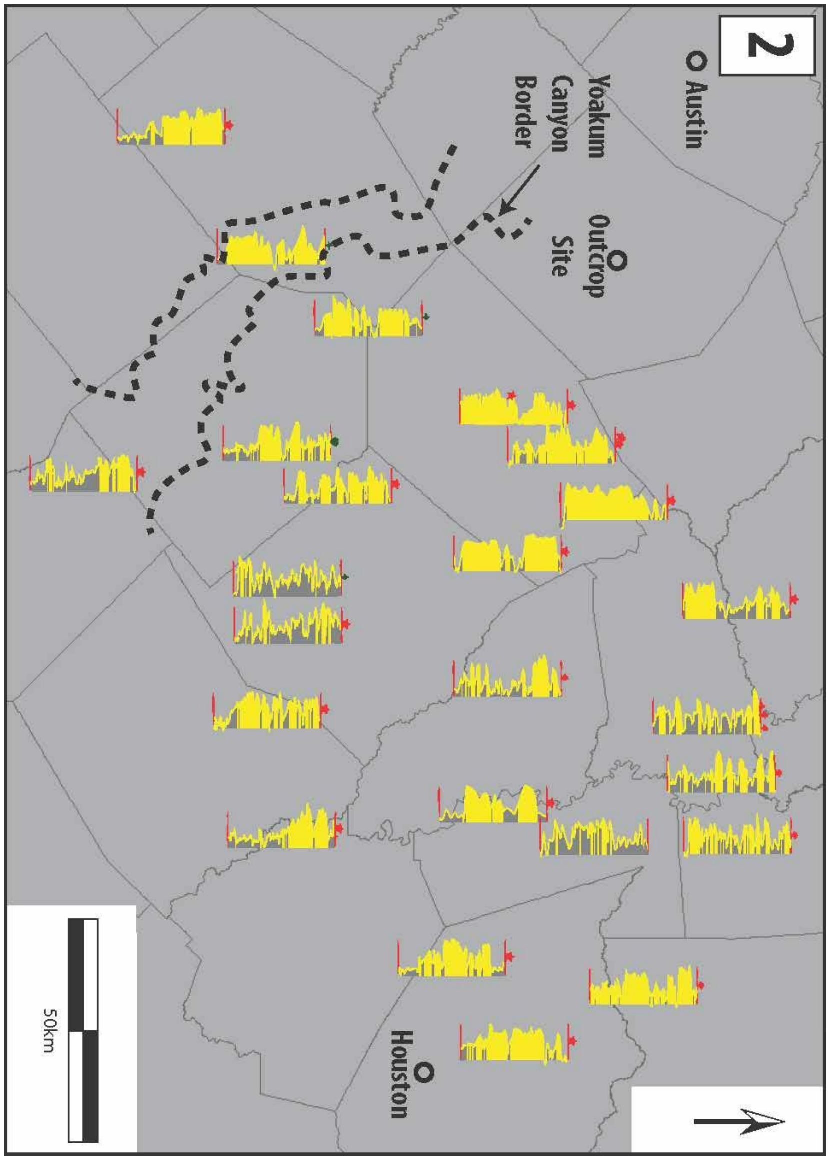
Appendix A

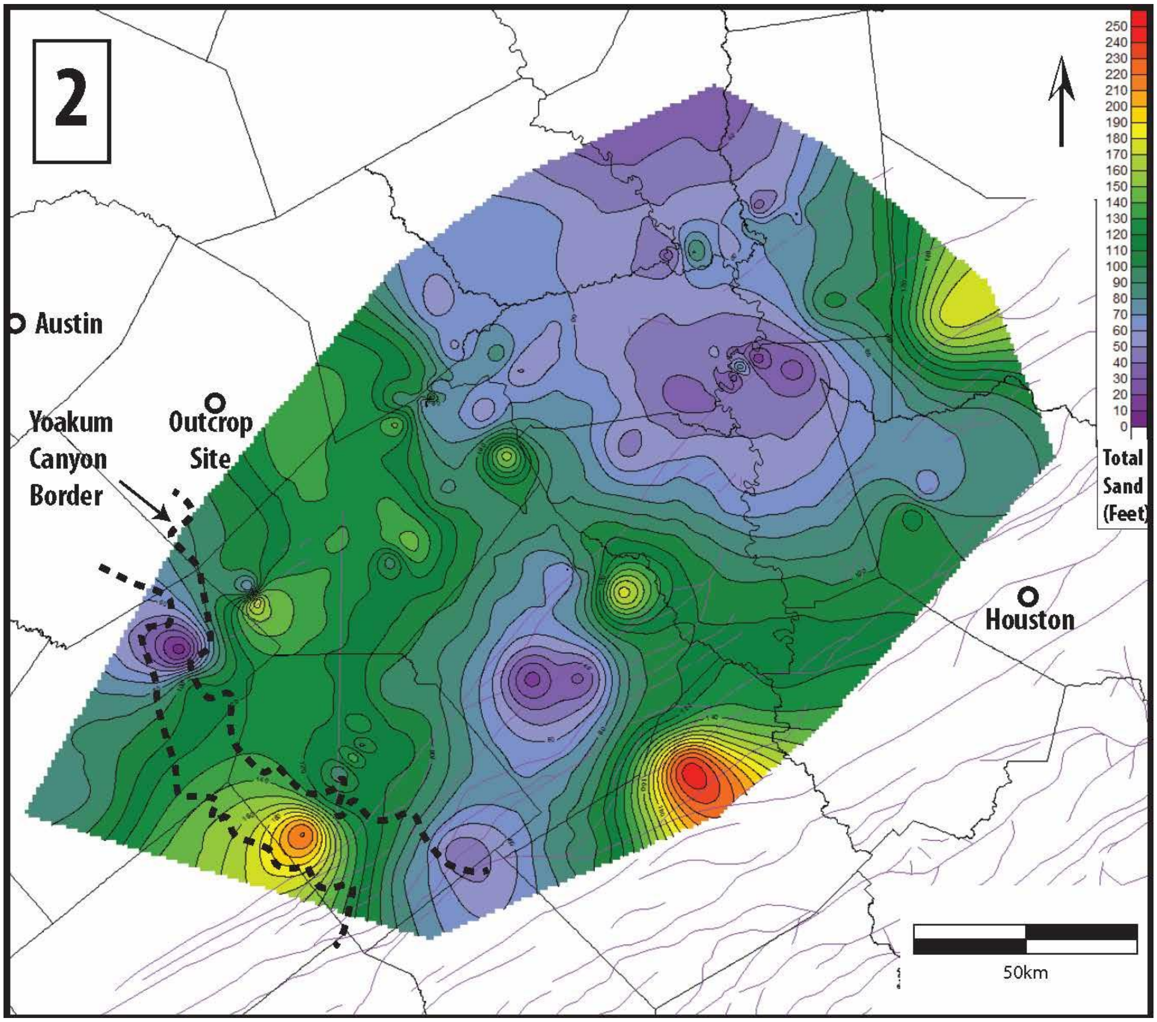
The maps are reproduced here in larger format.

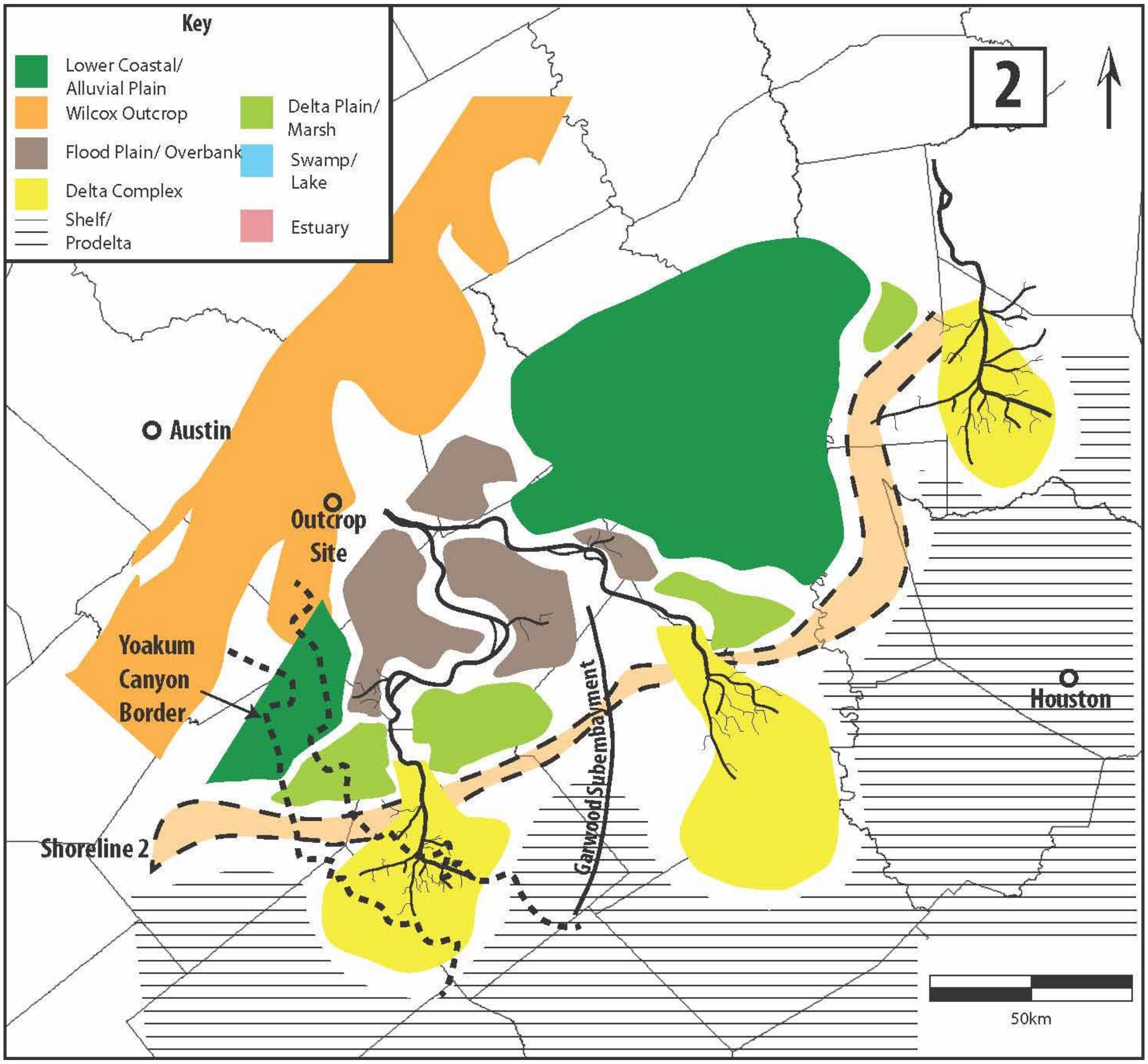

1
Austin
Yoakum Canyon Border
Outcrop Site
Delta
Channel
50km
Houston

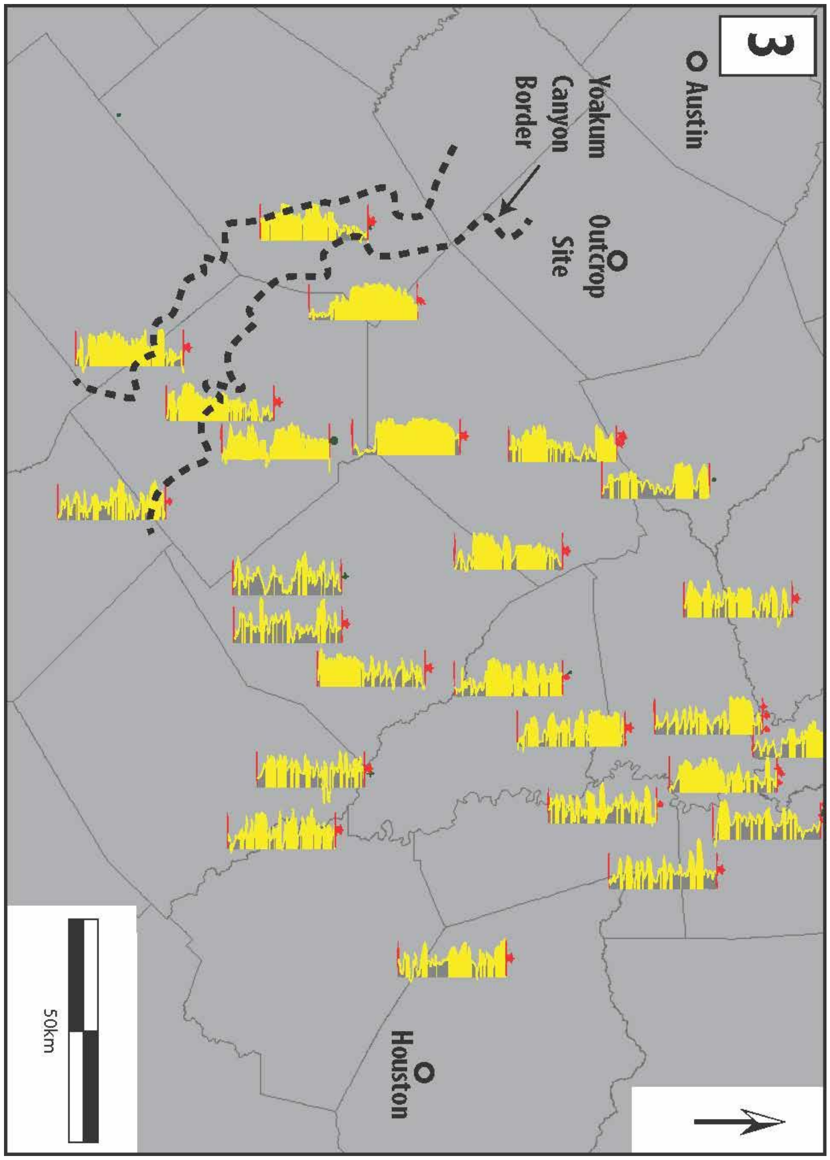

1
Austin
Outcrop Site
Yoakum Canyon Border
Houston
Total Sand (Feet)
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
50km

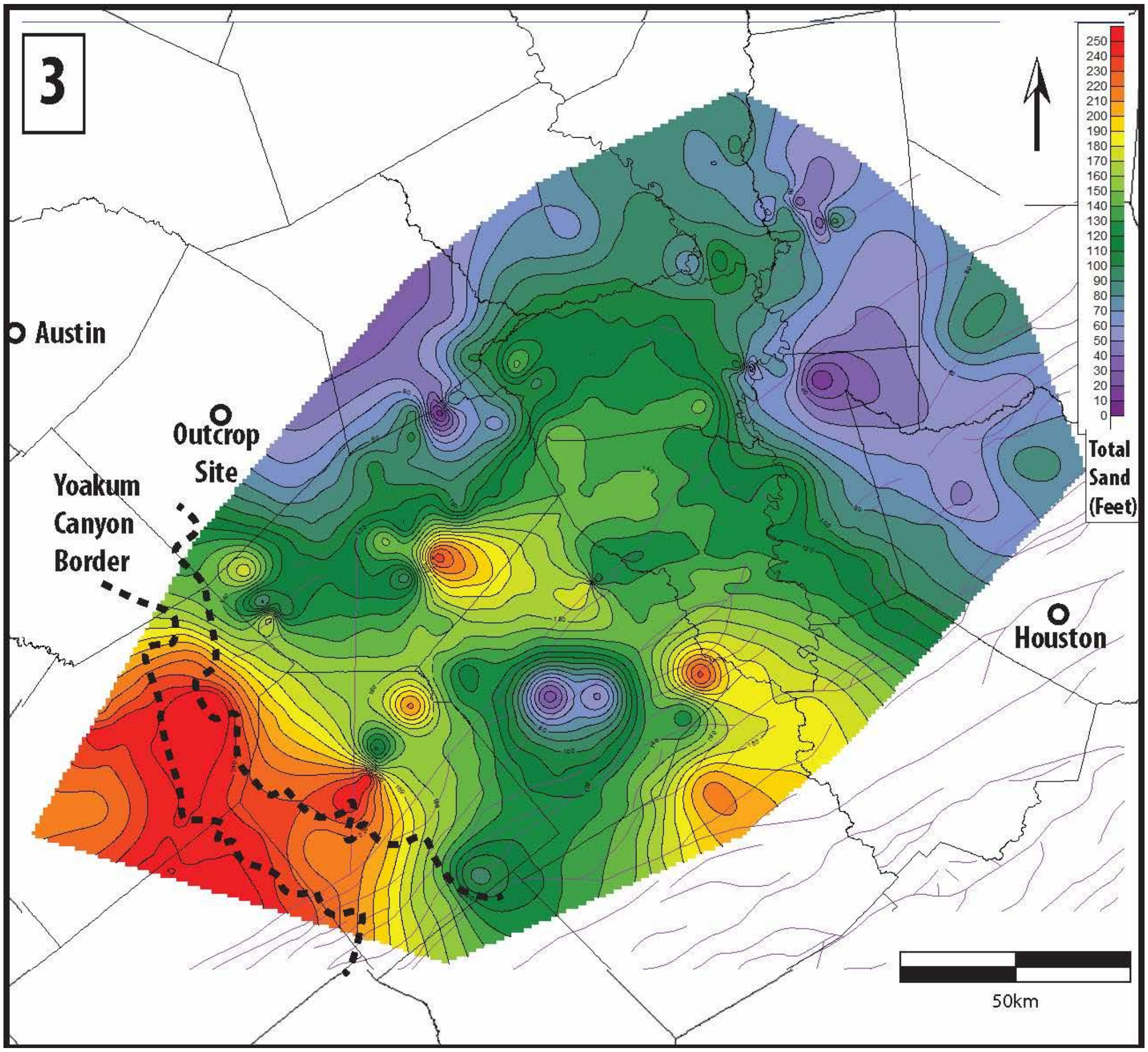

Key
Lower Coastal/ Alluvial Plain
Wilcox Outcrop
Flood Plain/ Overbank
Delta Complex
Shelf/ Prodelta
Delta Plain/ Marsh
Swamp/ Lake
Estuary
1
Austin
Outcrop Site
Houston
Shoreline 1
Yoakum Canyon
50km

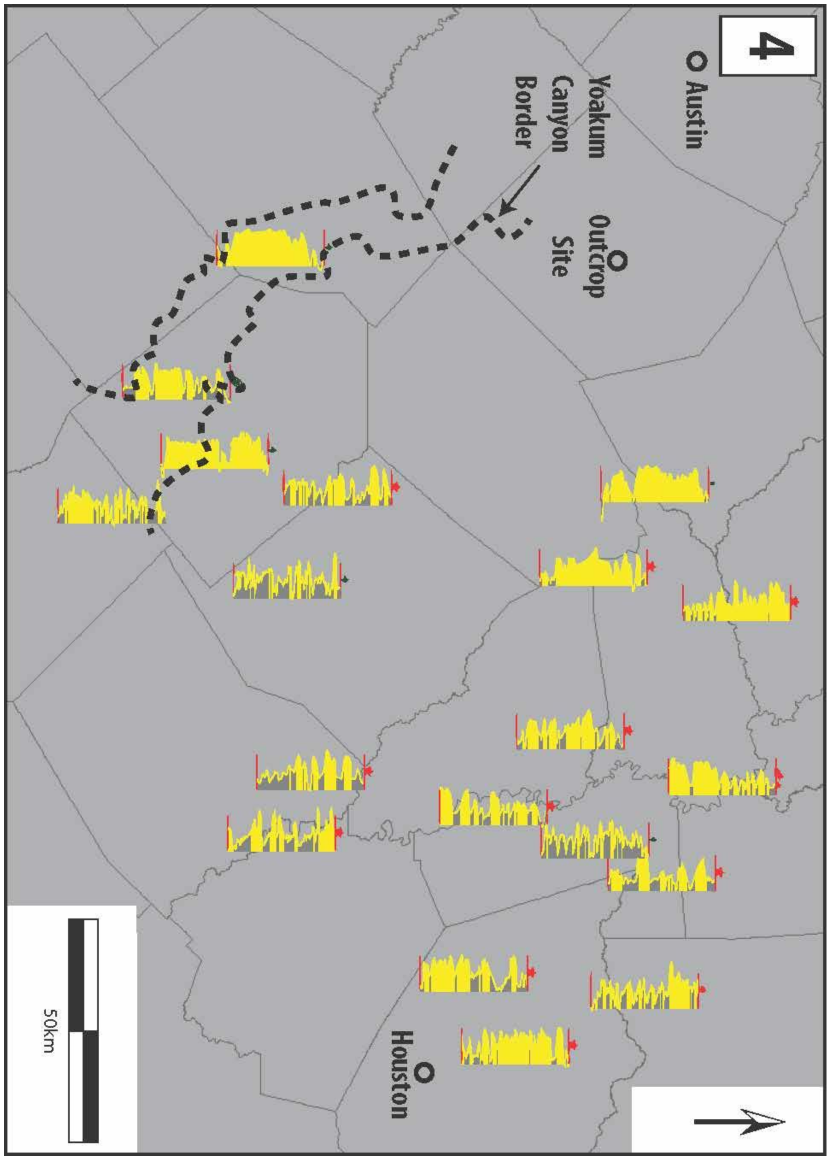

2
Austin
Yoakum
Canyon
Border
Outcrop
Site
Houston
50km

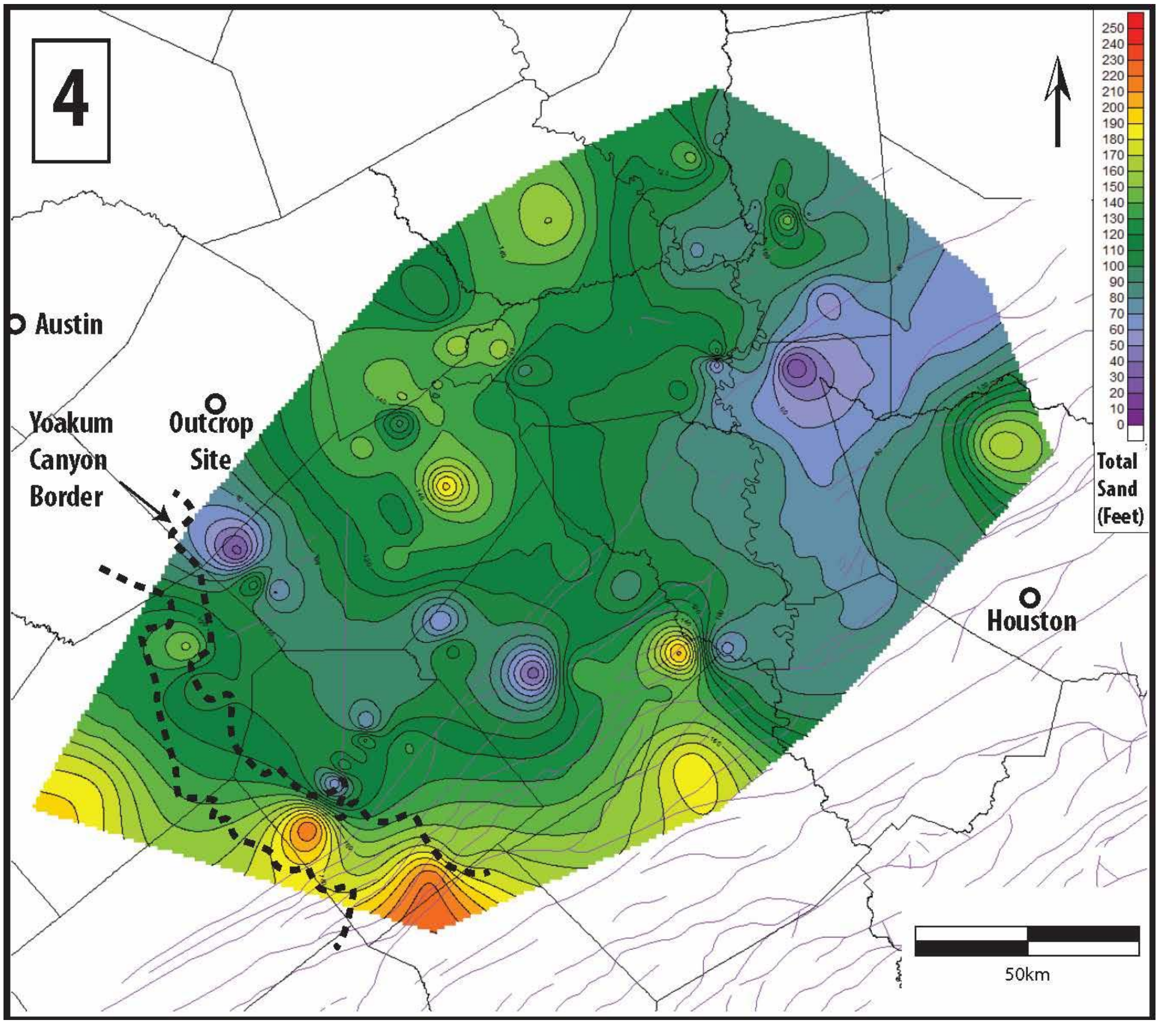

2
Austin
Yoakum
Canyon
Border
Outcrop
Site
Houston
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Total
Sand
(Feet)
50km

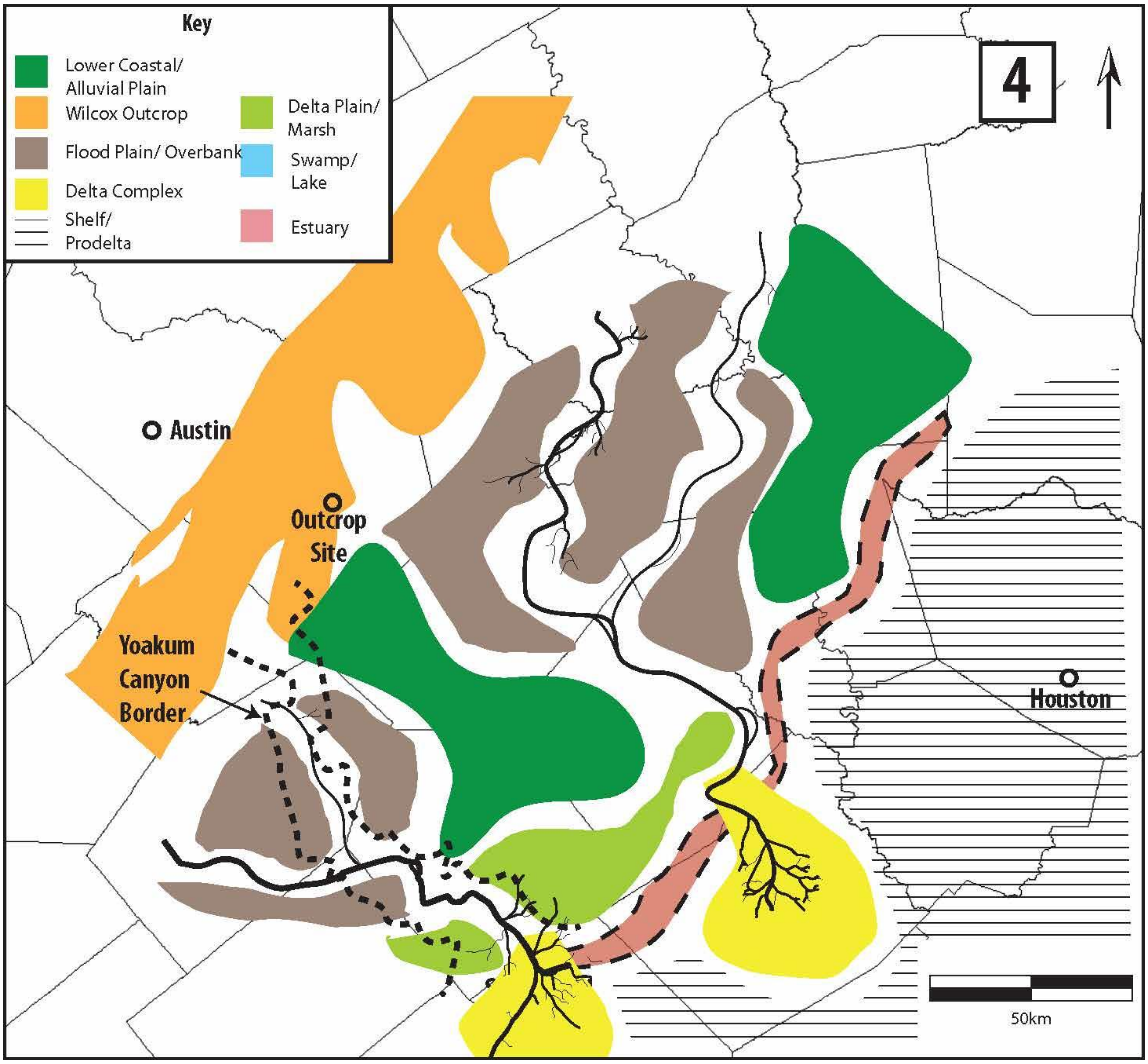

Key
Lower Coastal/ Alluvial Plain
Wilcox Outcrop
Flood Plain/ Overbank
Delta Complex
Shelf/ Prodelta
Delta Plain/ Marsh
Swamp/ Lake
Estuary
2
Austin
Outcrop Site
Yoakum Canyon Border
Shoreline 2
Garwood Subembayment
Houston
50km

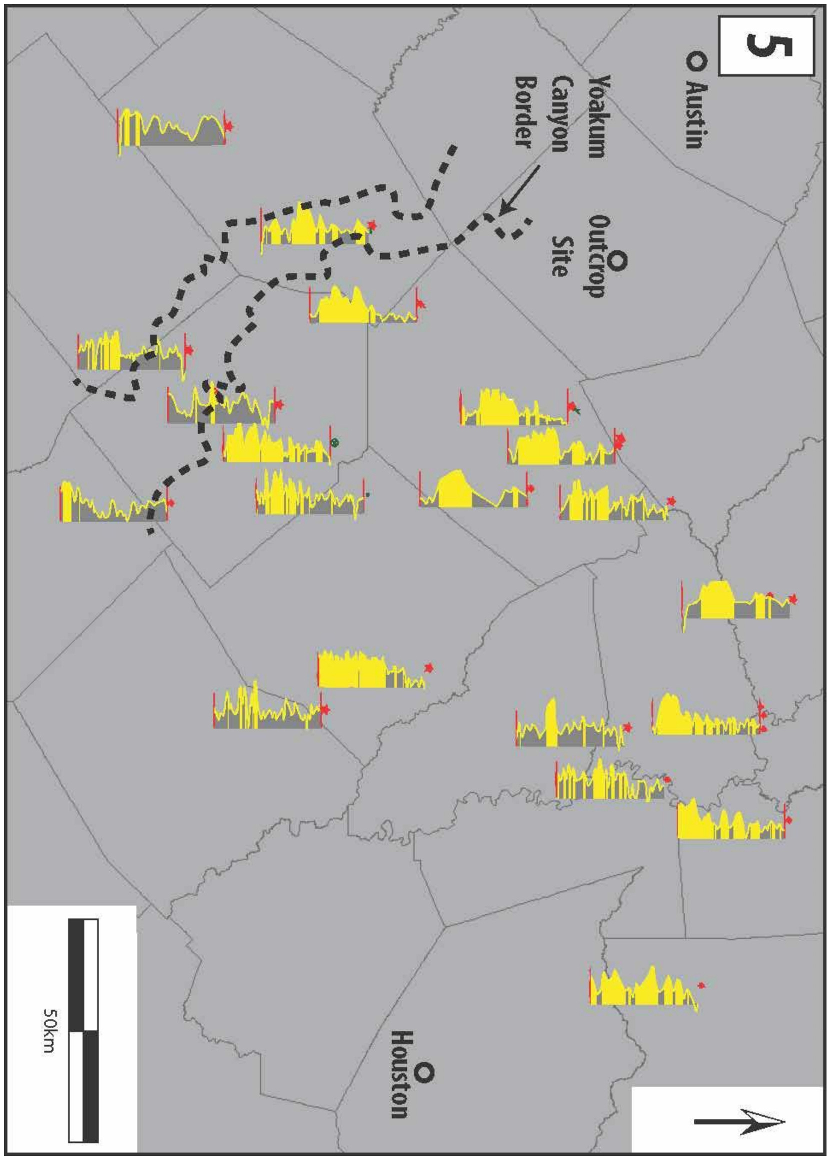

3
Austin
Yoakum
Canyon
Border
Outcrop
Site
Houston
50km

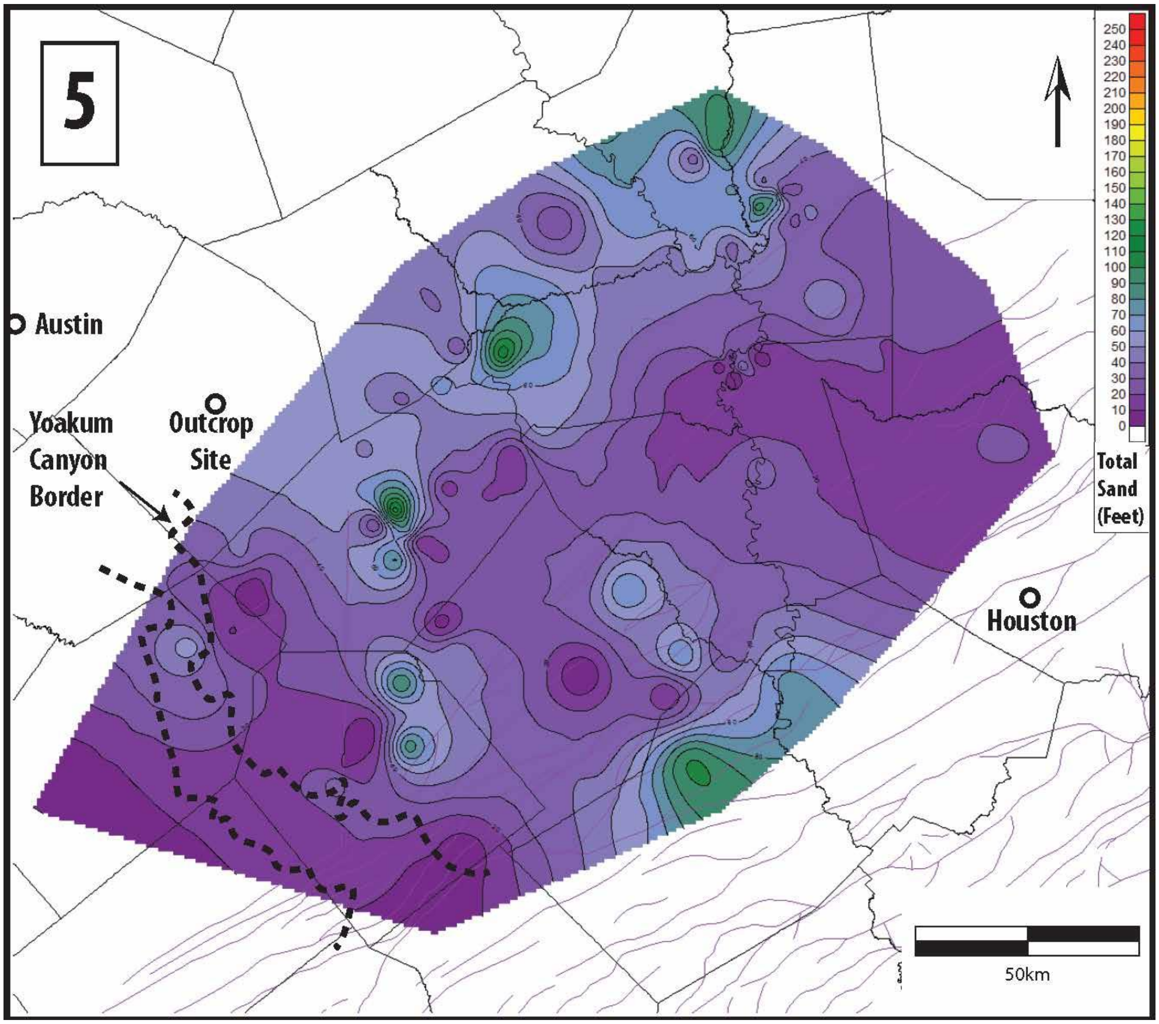

3
Austin
Outcrop Site
Yoakum Canyon Border
Houston
Total Sand (Feet)
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
50km

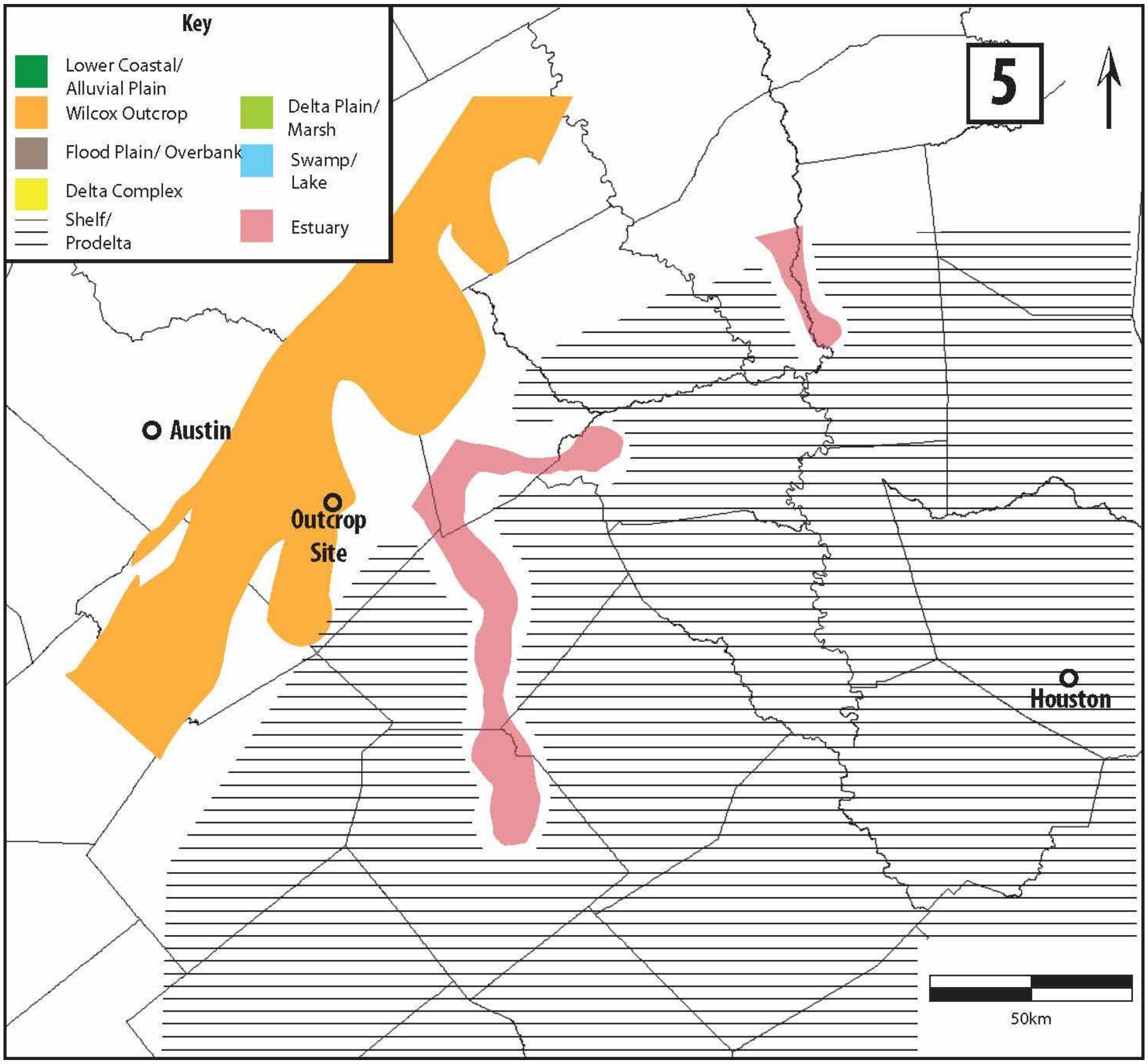

4
Austin
Yoakum
Canyon
Border
Outcrop
Site
Houston
50km


4
Austin
Outcrop Site
Yoakum Canyon Border
Houston
Total Sand (Feet)
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
50km


Key
Lower Coastal/ Alluvial Plain
Wilcox Outcrop
Flood Plain/ Overbank
Delta Complex
Shelf/ Prodelta
Delta Plain/ Marsh
Swamp/ Lake
Estuary
4
Austin
Outcrop Site
Yoakum Canyon Border
Houston
50km


5
Austin
Yoakum Canyon Border
Outcrop Site
Houston
50km


5
Austin
Outcrop Site
Yoakum Canyon Border
Houston
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Total Sand (Feet)
50km



Key
Lower Coastal/ Alluvial Plain
Wilcox Outcrop
Flood Plain/ Overbank
Delta Complex
Shelf/ Prodelta
Delta Plain/ Marsh
Swamp/ Lake
Estuary
5
Austin
Outcrop Site
Houston
50km

Appendix B

Outcrop measurements and calculations.

TALL PINES	Cross Sets (cm)						
	Section 1		Section 2		Section 3		
	Pkg A	Pkg B	Pkg C	Pkg D	Pkg E	Pkg F	
	20.00	25.00	15.00	25.00	25.00	30.00	
	20.00	25.00	25.00	30.00	35.00	30.00	
	15.00	30.00	15.00	25.00	40.00	30.00	
		25.00	20.00	20.00	25.00	30.00	
		30.00	15.00	25.00	30.00	35.00	
		30.00	10.00	30.00	40.00	25.00	
					30.00	10.00	
					20.00		
	Section 1		Section 2		Section 3		
Variable and Equation	Pkg 1	Pkg 2	Pkg 1	Pkg 2	Pkg 1	Pkg 2	Average Whole Outcrop
Average Cross Set Height (cm) (S_m) (Eq. 1)	18.33	27.50	16.67	25.83	30.63	27.14	24.35
Estimated Dune Height (cm) (h_m) (Eq. 2)	53.17	79.75	48.33	74.92	88.81	78.71	70.62
Paleoflow Depth (m) (D) (Eq. 3)	2.21	3.10	2.04	2.94	3.40	3.07	2.79

Width Estimate (m) (W) (Eq. 3)	64.76	109.43	57.25	100.93	125.77	107.59	94.29
Width/Depth ratio (F) (Eq. 4)	29.35	35.28	28.11	34.29	37.05	35.07	33.19
Sinuosity (P) (Eq. 5)	3.49	3.67	3.45	3.64	3.72	3.66	3.61
Mean Annual Discharge (cms) (Q_m) (Eq. 6)	30.75	89.35	23.93	75.80	118.60	86.33	70.79
Mean Annual Flood (cms) (Q_{ma}) (Eq. 7)	1151.20	2310.94	977.26	2075.50	2780.50	2259.60	1907.20
Channel Slope (S) (m/km) (Eq. 8)	13.57	9.77	14.66	10.27	8.95	9.87	11.18
Meander wavelength (L) (m) (Eq. 9)	1918.44	3037.09	1722.07	2829.40	3430.98	2992.44	2655.07

Tall Pines PC Values					
Section 1		Section 2		Section 3	
Pkg A	Pkg B	Pkg C	Pkg D	Pkg E	Pkg F
20.00	25.00	15.00	25.00	25.00	30.00
20.00	25.00	25.00	30.00	35.00	30.00
15.00	30.00	15.00	25.00	40.00	30.00
	25.00	20.00	20.00	25.00	30.00
	30.00	15.00	25.00	30.00	35.00
	30.00	10.00	30.00	40.00	25.00
				30.00	10.00
				20.00	

Sunshine Channel	Cross Sets (cm)										
	Section 1				Section 2				Section 3		
	Pkg 1	Pkg 2	Pkg 3	Pkg 4	Pkg 1	Pkg 2	Pkg 3	Pkg 4	Pkg 1	Pkg 2	Pkg 4
	25.00	30.00	20.00	40.00	45.00	50.00	20.00	25.00	25.00	30.00	35.00
	30.00	30.00		40.00	20.00	50.00		30.00	25.00	40.00	20.00
	30.00	25.00		40.00	15.00	25.00		25.00	25.00	40.00	20.00
	30.00	40.00		40.00	15.00	50.00		40.00	25.00	15.00	
	25.00			35.00	35.00	35.00			30.00		
				40.00	15.00				20.00		
				35.00					25.00		
				40.00					35.00		
									15.00		
									25.00		
									25.00		
									25.00		

	Section 1				Section 2				Section 3			
Variable and Equation	Pkg 1	Pkg 2	Pkg 3	Pkg 4	Pkg 1	Pkg 2	Pkg 3	Pkg 4	Pkg 1	Pkg 2	Pkg 4	Average Whole Outcrop
Average Cross Set Height (cm) (S_m) (Eq. 1)	28.00	31.25	20.00	39.00	26.00	42.00	20.00	30.00	26.00	31.25	25.00	28.95
Estimated Dune Height (cm) (h_m) (Eq. 2)	81.20	90.63	58.00	113.10	75.40	121.80	58.00	87.00	75.40	90.63	72.50	83.97
Paleoflow Depth (m) (D) (Eq. 3)	3.15	3.45	2.37	4.16	2.96	4.43	2.37	3.34	2.96	3.45	2.86	3.23

Width Estimate (m) (W) (Eq. 3)	112.01	129.10	72.48	171.95	101.77	189.25	72.48	122.46	101.77	129.10	96.73	118.10
Width/Depth ratio (F) (Eq. 4)	35.57	37.39	30.53	41.34	34.39	42.75	30.53	36.70	34.39	37.39	33.79	35.89
Sinuosity (P) (Eq. 5)	3.68	3.73	3.53	3.83	3.65	3.87	3.53	3.71	3.65	3.73	3.63	3.68
Mean Annual Discharge (cms) (Q_m) (Eq. 6)	93.69	125.07	38.66	224.02	77.09	272.24	38.66	112.33	77.09	125.07	69.53	113.95
Mean Annual Flood (cms) (Q_{ma}) (Eq. 7)	2383.62	2878.74	1336.89	4212.70	2098.57	4784.92	1336.89	2683.69	2098.57	2878.74	1961.77	2573.75
Channel Slope (S) (m/km) (Eq. 8)	9.62	8.80	12.64	7.36	10.22	6.93	12.64	9.10	10.22	8.80	10.55	9.72
Meander wavelength (L) (m) (Eq. 9)	3099.73	3510.42	2117.20	4512.00	2850.10	4907.21	2117.20	3351.76	2850.10	3510.42	2726.22	3232.03

Sunshine PC Values

Section 1				Section 2				Section 3		
Pkg 1	Pkg 2	Pkg 3	Pkg 4	Pkg 1	Pkg 2	Pkg 3	Pkg 4	Pkg 1	Pkg 2	Pkg 4
25	30	20	40	45	50	20	25	25	30	35
30	30		40	20	50		30	25	40	20
30	25		40	15	25		25	25	40	20
30	40		40	15	50		40	25	15	
25			35	35	35			30		
			40	15				20		
			35					25		
			40					35		
								15		
								25		
								25		
								25		

Dog Bark	Section 1			Section 2			
	Pkg 1	Pkg 2	Pkg 3	Pkg 1	Pkg 2	Pkg 3	
Cross sets	60.00	40.00	15.00	15.00	15.00	20.00	
	60.00	40.00	15.00	20.00	15.00	25.00	
	60.00	40.00	15.00	10.00	15.00	40.00	
	60.00	20.00	20.00	20.00	15.00		
	65.00	50.00	15.00	15.00			
	60.00	50.00		10.00			
	15.00			20.00			
	35.00			10.00			
	40.00			15.00			
	35.00			20.00			
				10.00			
				15.00			
				10.00			
				20.00			
				15.00			
				10.00			

				20.00			
				15.00			
				10.00			
				10.00			
				15.00			
	Section 1			Section 2			
Variable and Equation	Pkg 1	Pkg 2	Pkg 3	Pkg 1	Pkg 2	Pkg 3	Average Whole Outcrop
Average Cross Set Height (cm) (S_m) (Eq. 1)	49.00	40.00	16.00	14.52	15.00	28.33	27.14
Estimated Dune Height (cm) (h_m) (Eq. 2)	142.10	116.00	46.40	42.12	43.50	82.17	78.71
Paleoflow Depth (m) (D) (Eq. 3)	5.04	4.25	1.97	1.81	1.86	3.18	3.02
Width Estimate (m) (W) (Eq. 3)	231.02	177.68	54.31	47.92	49.96	113.74	112.43
Width/Depth ratio (F) (Eq. 4)	45.85	41.82	27.60	26.41	26.80	35.76	34.04
Sinuosity (P) (Eq. 5)	3.94	3.84	3.43	3.39	3.41	3.68	3.62
Mean Annual Discharge (cms) (Q_m) (Eq. 6)	408.40	239.45	21.49	16.66	18.14	96.65	133.47
Mean Annual Flood (cms) (Q_{ma}) (Eq. 7)	6236.37	239.45	21.49	16.66	18.14	96.65	99.38
Channel Slope (S) (m/km) (Eq. 8)	6.11	7.21	15.15	16.39	15.97	9.53	11.73

Meander wavelength (L) (m) (Eq. 9)	5843.65	4643.30	1644.24	1473.44	1528.30	3141.58	3045.75

Dog Bark PC Values

Pkg 1	Pkg 2	Pkg 3	Section 2		
60.00	40.00	15.00	Pkg 1	Pkg 2	Pkg 3
60.00	40.00	15.00	15.00	15.00	20.00
60.00	40.00	15.00	20.00	15.00	25.00
60.00	20.00	20.00	10.00	15.00	40.00
65.00	50.00	15.00	20.00	15.00	
60.00	50.00		15.00		
15.00			10.00		
35.00			20.00		
40.00			10.00		
35.00			15.00		
			20.00		
			10.00		
			15.00		
			10.00		
			20.00		
			15.00		
			10.00		
			20.00		
			15.00		
			10.00		
			10.00		
			15.00		

Appendix C

List of wells used in this project.

A-A' wells are highlighted in green (sample)

B-B' wells are highlighted in blue (sample)

C-C' wells are highlighted in yellow (sample)

D-D' wells are written in red (sample)

E-E' wells are written in blue (blue)

Please note that some wells appear in multiple cross sections.

UWI/API	LEASE	FIELD	COUNTY	WSN
42039321940000	TOWNSEND DAVID M SR	WILDCAT	BRAZORIA	3412
42039322490000	SHARP CORPORATION	WILDCAT	BRAZORIA	3478
42041316030000	ANDERSON	GIDDINGS	BRAZOS	5157
42041316090000	HIGH PRAIRIE RANCH	GIDDINGS	BRAZOS	5169
42041316180000	FITCH UNIT	GIDDINGS	BRAZOS	5189
42041316500000	ANDERSON	GIDDINGS	BRAZOS	5246
42041316750000	BORSKI-PETERS UNIT	GIDDINGS	BRAZOS	5297
42041316980000	MCGRUDER ANDERSON UN	GIDDINGS	BRAZOS	5328
42041317030000	BOYETT LOHNIE	WILDCAT	BRAZOS	5341
42041317150000	ARHOPULOS T J	CLAY NORTHEAST	BRAZOS	5370
42041317190000	MOORE TOM	CLAY NORTHEAST	BRAZOS	5377
42041317320000	MCFARLANE-MOORE UNIT	CLAY NORTHEAST	BRAZOS	5399
42041317420000	KEYSER W B	GIDDINGS	BRAZOS	5423
42041317470000	LOMETA	GIDDINGS	BRAZOS	5440
42041317570000	MCCULLOUGH A W	GIDDINGS	BRAZOS	5461
42041317580000	ATKINS J M UNIT	GIDDINGS	BRAZOS	5464
42041317600000	FROST	GIDDINGS	BRAZOS	5469
42041317640000	JERICHO-VILAS	CLAY NORTHEAST	BRAZOS	5473
42041317680000	ARHOPULOS-CRENSHAW U	GIDDINGS	BRAZOS	5479
42041317770000	RITCHEY	GIDDINGS	BRAZOS	5505
42041317780000	WHITMORE	GIDDINGS	BRAZOS	5506
42041317820000	DUNLAP-BRYAN UNIT	GIDDINGS	BRAZOS	5518
42041317990000	DUNLAP UNIT	GIDDINGS	BRAZOS	5550

42041318090000	TREATMENT PLANT	GIDDINGS	BRAZOS	5570
42041318100000	LINDLEY	GIDDINGS	BRAZOS	5572
42041318150000	PODRAZA-ROTELLO UN	GIDDINGS	BRAZOS	5581
42041318210000	MILLICAN	GIDDINGS	BRAZOS	5592
42041318260000	MOORE	GIDDINGS	BRAZOS	5604
42041318350000	DINKINS UNIT	GIDDINGS	BRAZOS	5626
42041318370000	ELLIOTT OL	GIDDINGS	BRAZOS	5634
42041318400000	WESTLANDS	GIDDINGS	BRAZOS	5645
42041318450000	SALVAGGIO OL	GIDDINGS	BRAZOS	5655
42041318480000	WRIGHT ANNA UNIT	GIDDINGS	BRAZOS	5672
42041318500000	VILAS-WALTON	GIDDINGS	BRAZOS	5676
42041318600000	KATHLEEN OL	GIDDINGS	BRAZOS	5692
42041318610000	T J M OL	GIDDINGS	BRAZOS	5696
42041318660000	KURTEN WOODBINE UN	KURTEN	BRAZOS	5708
42041318800000	ARNOLD UNIT	GIDDINGS	BRAZOS	5740
42041318850000	BERNADINE DL	GIDDINGS	BRAZOS	5757
42041318910000	SIX SHOOTER	MILLICAN DOME	BRAZOS	5768
42041319210000	SIX SHOOTER	MILLICAN DOME	BRAZOS	5824
42041319220000	SIX SHOOTER	MILLICAN DOME	BRAZOS	5825
42041319310000	KURTEN WOODBINE UNIT	KURTEN	BRAZOS	5839
42041319470000	MOORE THOMAS	GIDDINGS	BRAZOS	5868
42041319570000	RICKY THIRTY FOUR	AGGIELAND	BRAZOS	5893
42041319720000	LINDLEY	GIDDINGS	BRAZOS	5923
42041319920000	GREEN MILTON	AGGIELAND	BRAZOS	5961
42051000230000	MARGARET BLACK	CHAMBERS	BURLESON	6159
42051000240000	BOYD & EANES	CHAMBERS	BURLESON	6160
42051000250000	HITCHCOCK F A	WILDCAT	BURLESON	6161
42051000270000	YARRELL THOMAS	WILDCAT	BURLESON	6163
42051000410000	WORTHINGTON H	WILDCAT	BURLESON	6177
42051000720000	MARION WILKINS HOHK	WILDCAT	BURLESON	6208
42051300020000	E CRUMP JR	WILDCAT	BURLESON	6288
42051300030000	RUSSELL ETAL	WILDCAT	BURLESON	6289
42051300090000	ARTHUR PRAESEL	BRIAR BRANCH	BURLESON	6295
42051300660000	HOHLT WILKIN		BURLESON	6346
42051300670000	HOHLT WILKIN	WILDCAT	BURLESON	6347
42051300700000	HOHLT-WILKIN	WILDCAT	BURLESON	6350
42051301100000	JESSIE MOORE EST	CLAY NORTHEAST	BURLESON	6384
42051301130000	DAVID BLACK	CHAMBERS	BURLESON	6388
42051301160000	CHARLES BOEDEKER	CHAMBERS	BURLESON	6390
42051301290000	ALDERMAN	WILDCAT	BURLESON	6401
42051302920000	HAISH	WILDCAT	BURLESON	6414
42051303110000	TEXAS A&M /A/	WILDCAT	BURLESON	6432
42051304010000	WM GOUGH	WILDCAT	BURLESON	6539
42051304690000	WILLARD E R	WILLARD	BURLESON	6614
42051305590000	STEGMUELLER	GIDDINGS	BURLESON	6717
42051306010000	BAKER E R ETAL	WILDCAT	BURLESON	6752
42051306140000	HUDDLESTON UNIT	CALDWELL	BURLESON	6778

42051306260000	PITTS-RUNYAN	CALDWELL	BURLESON	6791
42051306890000	MCFARLAND J	GIDDINGS	BURLESON	6864
42051307520000	NEWMAN JOHN	GIDDINGS	BURLESON	6940
42051307670000	WILKINS	CLAY NORTHEAST	BURLESON	6958
42051308030000	KARISCH	GIDDINGS	BURLESON	6999
42051308100000	KNOLLE R H	CALDWELL	BURLESON	7008
42051308170000	WEST BIRCH CRK PARK	GIDDINGS	BURLESON	7015
42051309300000	MEYERS N L UNIT	GIDDINGS	BURLESON	7152
42051309500000	MOORE JESSE B	CLAY NORTHEAST	BURLESON	7176
42051309890000	BLINKA J UNIT	CALDWELL	BURLESON	7220
42051310550000	COFFIELD B-7B	NOACK COW HERD	BURLESON	7297
42051311040000	SETTEGAST OPERS UN	GIDDINGS	BURLESON	7360
42051311600000	WOLFE BOYD V	GIDDINGS	BURLESON	7424
42051312170000	MOORE JESSE B	CLAY NORTHEAST	BURLESON	7497
42051312640000	PAULA	GIDDINGS	BURLESON	7550
42051313540000	HENSON C R UNIT	GIDDINGS	BURLESON	7647
42051314050000	ODC	GIDDINGS	BURLESON	7709
42051314060000	CHMELAR GEORGE	GIDDINGS	BURLESON	7710
42051314420000	SMITH MABLE UNIT	GIDDINGS	BURLESON	7754
42051314550000	BRISCOE BELLE UNIT	GIDDINGS	BURLESON	7770
42051314930000	MOORE JESSE	CLAY NORTHEAST	BURLESON	7820
42051315730000	SAUNDERS D A	GIDDINGS	BURLESON	7923
42051316070000	ZGABAY MARY ANN /A/	GIDDINGS	BURLESON	7959
42051316770000	BERRY VARREECE	GIDDINGS	BURLESON	8041
42157010260000	ELIZABETH MCKENNON	WILDCAT	FORT BEN	9828
42157318940000	DUSEK	COOLEY	FORT BEN	10295
42157319450000	SULAK	COOLEY	FORT BEN	10356
42157319530000	WINGATE	COOLEY	FORT BEN	10364
42157319870000	COLONY	COOLEY	FORT BEN	10407
42157319910000	COLONY	COOLEY	FORT BEN	10411
42157319980000	BENTON TRUST	ROSENBERG NORTH	FORT BEN	10418
42157320040000	GRIGAR	COOLEY	FORT BEN	10428
42157320930000	MOORE ESTATE	WILDCAT	FORT BEN	10531
42157321330000	DUSEK	COOLEY	FORT BEN	10574
42157321460000	STADE EDWIN	BEASLEY NORTH	FORT BEN	10587
42157321690000	DALIO	ENDURANCE	FORT BEN	10615
42157321780000	DUSEK	COOLEY	FORT BEN	10629
42157321830000	EL FERROCARRIL LTD	COOLEY	FORT BEN	10634
42157321890000	KRENEK	COOLEY	FORT BEN	10640
42157322180000	FOSTER FARMS DEEP	FULSHEAR SOUTH	FORT BEN	10674
42157322280000	EL FERROCARRIL LTD	COOLEY	FORT BEN	10687
42157322520000	COLONY	COOLEY	FORT BEN	10718
42157322530000	KRENEK FRANK UNIT	COOLEY	FORT BEN	10719
42157322540000	COLONY	COOLEY	FORT BEN	10720
42157322650000	DUSEK	COOLEY	FORT BEN	10733
42157322750000	MCMILLIAN	FULSHEAR SOUTH	FORT BEN	10742
42157323630000	GLESS	FULSHEAR SOUTH	FORT BEN	10844

42157323710000	F A S H DEEP A	FULSHEAR SOUTH	FORT BEN	10852
42157323840000	GRIGAR	COOLEY	FORT BEN	10865
42157324230000	HORELICA	COOLEY	FORT BEN	10905
42157324490000	FOSTER FARMS DEEP	FULSHEAR SOUTH	FORT BEN	10932
42157324990000	FASH DEEP	FULSHEAR SOUTH	FORT BEN	10986
42185301940000	JOHNSON	HILL	GRIMES	13731
42185301980000	M B SANDERS	IOLA	GRIMES	13826
42185302010000	F E MEYER	WILDCAT	GRIMES	13829
42185302030000	ESTELLE M POWLEDGE	WILDCAT	GRIMES	13831
42185302040000	CONELEY-GALBREATH 1	MARTINS PRAIRIE	GRIMES	13832
42185302140000	DARBY GERALDINE	WILDCAT	GRIMES	13845
42185302170000	MALLETT	IOLA	GRIMES	13849
42185302240000	WILLIAMS	SINGLETON D3	GRIMES	13859
42185302250000	TRANT	MARTINS PRAIRIE	GRIMES	13861
42185302260000	ANDRESS	WILDCAT	GRIMES	13862
42185302280000	HALL DARRELL	WILDCAT	GRIMES	13864
42185302320000	COCKRELL CORP	WILDCAT	GRIMES	13868
42185302340000	SCAMARDO UNIT NO 1	IOLA	GRIMES	13872
42185302350000	WALTRIP ROBERT ETAL	WILDCAT	GRIMES	13874
42185302410000	GARDNER WILLIAM	WHITEHALL D3	GRIMES	13880
42185302440000	HOLTH A	IOLA	GRIMES	13883
42185302490000	HARRISON		GRIMES	13888
42185302540000	JOHNSON	WILDCAT	GRIMES	13893
42185302630000	MCCRARY D A	MARTINS PRAIRIE	GRIMES	13903
42185302660000	TRANT	WILDCAT	GRIMES	13906
42185302680000	CORLEY J H	IOLA	GRIMES	13908
42185302710000	HOWARD J C ETAL	MARTINS PRAIRIE	GRIMES	13911
42185302740000	COWAN-ZOLLMAN ETAL	COROLLA	GRIMES	13913
42185302750000	GILPIN	WILDCAT	GRIMES	13914
42185302780000	SEGLER LB	WILDCAT	GRIMES	13917
42185302800000	GARRETT ESTATE	MADISONVILLE S	GRIMES	13919
42185302990000	PETEETE-AMOCO		GRIMES	13940
42185303010000	KENNARD	MARTINS PRAIRIE	GRIMES	13942
42185303050000	FUQUA L R ETVIR	FUQUA	GRIMES	13947
42185303090000	JOHNSON	MARTINS PRAIRIE	GRIMES	13950
42185303110000	MEDLAND ESTATE	MARTINS PRAIRIE	GRIMES	13951
42185303120000	JOSEY ESTATE ETAL	WILDCAT	GRIMES	13952
42185303250000	SCOGGINS	IOLA	GRIMES	13963
42185303280000	SIRACUSA D A ETAL	WILDCAT	GRIMES	13966
42185303350000	COBB	IOLA SOUTH	GRIMES	13976
42185303480000	GARRETT ESTATE	MADISONVILLE NE	GRIMES	13990
42185303490000	BEENE	MARTINS PRAIRIE	GRIMES	13992
42185303560000	URBANAGRA CORP	URBANOSKY	GRIMES	13998
42185303600000	BLOUNT	MARTINS PRAIRIE	GRIMES	14000
42185303680000	T M P A	MARTINS PRAIRIE	GRIMES	14006
42185303720000	HOWARD J C	WILDCAT	GRIMES	14009
42185303730000	BUSHMAN WILLIAM	WILDCAT	GRIMES	14010

42185303750000	POWLEDGE	MADISONVILLE S	GRIMES	14012
42185303760000	DIRKS G	KEITH	GRIMES	14015
42185303790000	TMPA	MARTINS PRAIRIE	GRIMES	14018
42185303840000	APOLONIA	WILDCAT	GRIMES	14025
42185303860000	POWLEDGE	MADISONVILLE SW	GRIMES	14029
42185303900000	BRADY	ZULCH NORTH	GRIMES	14035
42185303930000	HEATH OREY D ESTATE	MADISONVILLE S	GRIMES	14040
42185303970000	SCHWARZ	BLUE GUM	GRIMES	14044
42185303980000	CURTIS COOK ETHA	MARTINS PRAIRIE	GRIMES	14045
42185304020000	SCHROEDER G W	WILDCAT	GRIMES	14049
42185304080000	MCWHORTER	BLUE GUM	GRIMES	14054
42185304100000	BUTLER	PLANTERSVILLE	GRIMES	14057
42185304130000	HUNTER - BRADY	BLUE GUM	GRIMES	14059
42185304140000	THOMAS J T	MARTINS PRAIRIE	GRIMES	14060
42185304160000	JBW	WILDCAT	GRIMES	14062
42185304180000	JBW - TMPA	MARTINS PRAIRIE	GRIMES	14063
42185304200000	COLE	WILDCAT	GRIMES	14065
42185304230000	UNION FEE	WILDCAT	GRIMES	14068
42185304240000	MEADORS G S	MARTINS PRAIRIE	GRIMES	14069
42185304280000	CLEGHORN T	WILDCAT	GRIMES	14073
42185304300000	LANDERS GEORGETOWN G	IOLA EAST	GRIMES	14076
42185304330000	DENMAN UNIT	IOLA	GRIMES	14085
42185304390000	JOHNSON RANCH	HILL	GRIMES	14094
42185304410000	SANDERS	GIDDINGS	GRIMES	14098
42185304420000	MAXWELL	MARTINS PRAIRIE	GRIMES	14099
42185304450000	TMPA	GALJOUR	GRIMES	14104
42185304460000	WELLMAN OL	GIDDINGS	GRIMES	14106
42185304470000	SNR OIL	GIDDINGS	GRIMES	14108
42185304480000	MOODY	GIDDINGS	GRIMES	14110
42185304490000	HUSFELD	GIDDINGS	GRIMES	14111
42185304500000	T M P A	GIDDINGS	GRIMES	14112
42185304510000	GORBET	GIDDINGS	GRIMES	14113
42185304520000	HEGAR OL	GIDDINGS	GRIMES	14115
42185304530000	BEARD OL	GIDDINGS	GRIMES	14118
42185304550000	STOUT OL	GIDDINGS	GRIMES	14120
42185304560000	PHILIP	GIDDINGS	GRIMES	14122
42185304590000	NAVASOTA UNIT	GIDDINGS	GRIMES	14128
42185304640000	ROCKY CREEK OL	GIDDINGS	GRIMES	14139
42185304660000	ERWIN OL	GIDDINGS	GRIMES	14144
42185304730000	FRANKS OL	GIDDINGS	GRIMES	14172
42185304790000	RODES	GIDDINGS	GRIMES	14191
42185304800000	STANLEY OL	GIDDINGS	GRIMES	14194
42185304810000	BARTLETT UNIT	GIDDINGS	GRIMES	14197
42185304830000	CARLOS DOME `A` UNIT	GIDDINGS	GRIMES	14201
42185304880000	BERKLEY	GIDDINGS	GRIMES	14210
42185304890000	NORWOOD UNIT	IOLA	GRIMES	14211
42185304900000	MINERAL SPRINGS	GIDDINGS	GRIMES	14214

42185304910000	GIBBONS CREEK	GIDDINGS	GRIMES	14215
42185304940000	BETTY	GIDDINGS	GRIMES	14221
42185304950000	HANNAH	GIDDINGS	GRIMES	14223
42185304960000	HARVILL	GIDDINGS	GRIMES	14224
42185304980000	MALLETT UNIT	IOLA	GRIMES	14227
42185305010000	TURKEY CREEK	GIDDINGS	GRIMES	14236
42185305060000	GRANT UNIT	IOLA	GRIMES	14252
42185305100000	WARREN UNIT	IOLA	GRIMES	14259
42185305110000	ANDERSON-HILL UNIT	GIDDINGS	GRIMES	14261
42185305130000	PASKET UNIT	GIDDINGS	GRIMES	14268
42185305140000	PERRY	NAVASOTA RIVER	GRIMES	14270
42185305190000	IOLA-BLAGRAVES UNIT	IOLA	GRIMES	14280
42185305200000	SONTAG UNIT	GIDDINGS	GRIMES	14281
42185305240000	STANLEY OL	GIDDINGS	GRIMES	14288
42185305250000	MCGEE OL	GIDDINGS	GRIMES	14289
42185305290000	PEARSON UNIT	IOLA	GRIMES	14299
42185305340000	HOPSON	GIDDINGS	GRIMES	14308
42185305350000	FREDERICK	GIDDINGS	GRIMES	14311
42185305390000	MORAN	IOLA	GRIMES	14319
42185305410000	GARRETT	GIDDINGS	GRIMES	14322
42185305440000	DENMAN	GIDDINGS	GRIMES	14326
42185305450000	EPHRAIM OL	GIDDINGS	GRIMES	14327
42185305460000	PEIDMONT	GIDDINGS	GRIMES	14330
42185305500000	MCWHORTER UNIT	IOLA	GRIMES	14334
42185305520000	ARMSTRONG	GIDDINGS	GRIMES	14337
42185305530000	REBECCA	GIDDINGS	GRIMES	14343
42185305550000	HOLLISTER	GIDDINGS	GRIMES	14347
42185305560000	CONKLING	GIDDINGS	GRIMES	14349
42185305650000	HEIL	GIDDINGS	GRIMES	14365
42185305660000	GIBBONS CREEK	GIDDINGS	GRIMES	14366
42185305670000	EPHRAIM OL	GIDDINGS	GRIMES	14372
42185305730000	CLAIRE OL	GIDDINGS	GRIMES	14382
42185305760000	LAURA OL	GIDDINGS	GRIMES	14388
42185305780000	WILSON	GIDDINGS	GRIMES	14393
42185305820000	YVONNE 1-H	GIDDINGS	GRIMES	14396
42185305830000	URIAH	GIDDINGS	GRIMES	14398
42185305840000	WICHMAN	GIDDINGS	GRIMES	14401
42185305850000	BOATWRIGHT	GIDDINGS	GRIMES	14402
42185305860000	NEBLETT	GIDDINGS	GRIMES	14405
42185305870000	HARTMAN	GIDDINGS	GRIMES	14407
42185306050000	URIAH OL	NAVASOTA RIVER	GRIMES	14443
42185306060000	MCNEALY	NAVASOTA RIVER	GRIMES	14444
42185306160000	AIRPORT	NAVASOTA RIVER	GRIMES	14459
42185306350000	PEACH	NAVASOTA RIVER	GRIMES	14490
42185306410000	KNOTTS UNIT	IOLA	GRIMES	14497
42185307040000	MCCUNE	GIDDINGS	GRIMES	14601
42185307170000	PIRTLAW	NAVASOTA RIVER	GRIMES	14623

42185307290000	BUTAUD `E`	GIDDINGS	GRIMES	14644
42185307370000	WELLS E	GIDDINGS	GRIMES	14655
42185307480000	WILKERSON-DAVIS UNIT	GIDDINGS	GRIMES	14673
42201000050000	PERKINS W A	WILDCAT	HARRIS	14761
42339306650000	M & M MINERALS	WILDCAT	MONTGOME	18218
42339306730000	CENTRAL COAL & COKE	WILDCAT	MONTGOME	18228
42339306910000	MOORE H N	CONROE SOUTH	MONTGOME	18255
42339306920000	BENDER UNIT /A/	WILDCAT	MONTGOME	18256
42339306950000	BLAKE	WILDCAT	MONTGOME	18263
42339306960000	FOSTER ESTATE	FOSTER D3	MONTGOME	18264
42339306970000	KOG WELCH	PINEHURST SW	MONTGOME	18265
42339306980000	ANCHOR FINANCIAL COR	DECKERS PRAIRIE	MONTGOME	18267
42339307130000	KUNTZ T E ET AL	WILDCAT	MONTGOME	18294
42339307160000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18302
42339307200000	CHAMPION REALITY COR	WILDCAT	MONTGOME	18311
42339307210000	M & M MINERALS	LAKE CREEK	MONTGOME	18313
42339307220000	HEINTZ DOLLY	WILDCAT	MONTGOME	18314
42339307230000	WINSLOW PERRY F	WILDCAT	MONTGOME	18315
42339307250000	WELCH	PINEHURST SW	MONTGOME	18317
42339307300000	BENDER ESTATES /A/	REMBERT	MONTGOME	18324
42339307440000	FOSTER ESTATE /B/	FOSTER D3	MONTGOME	18350
42339307570000	FOSTER ESTATE	FOSTER SOUTH	MONTGOME	18371
42339307630000	KING R V	LAKE CREEK EAST	MONTGOME	18380
42339307800000	UNGER POP	LAKE CREEK EAST	MONTGOME	18403
42339307830000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18407
42339307880000	WILLIAMS UNIT	LAKE CREEK EAST	MONTGOME	18416
42339307890000	HILL J	LAKE CREEK EAST	MONTGOME	18417
42339307910000	BENDER	WILDCAT	MONTGOME	18419
42339307950000	KAYSER	LAKE CREEK EAST	MONTGOME	18424
42339308000000	WINSLOW	PINEHURST	MONTGOME	18432
42339308030000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18438
42339308050000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18442
42339308060000	HAGAN F	PINEHURST	MONTGOME	18444
42339308120000	BERTRAND	LAKE CREEK EAST	MONTGOME	18454
42339308140000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18457
42339308240000	WILDWOOD ESTATES `MS	PINEHURST	MONTGOME	18475
42339308250000	MICHEL ETAL	DECKERS PRAIRIE	MONTGOME	18478
42339308290000	FRIENDSWOOD DEVELOPM	FOSTORIA	MONTGOME	18483
42339308380000	BAHR	BENDER	MONTGOME	18497
42339308400000	WOODLANDS	WOODLANDS	MONTGOME	18499
42339308420000	STEELE N RUTH	DECKERS PRAIRIE	MONTGOME	18502
42339308470000	FRIENDSWOOD DEVELOPM	FOSTORIA	MONTGOME	18507
42339308480000	CHAMPION	WILDCAT	MONTGOME	18508
42339308500000	MASTERS	WILDCAT	MONTGOME	18510
42339308520000	BAYER G	DECKERS PRAIRIE	MONTGOME	18512
42339308580000	PINEHURST	PINEHURST	MONTGOME	18521
42339308590000	WINSLOW	PINEHURST	MONTGOME	18523

42339308620000	M & M MINERALS	WILDCAT	MONTGOME	18527
42339308640000	PECKINPAUGH	BENDER	MONTGOME	18529
42339308650000	TALAMAS-HOLDERRIETH	DECKERS PRAIRIE	MONTGOME	18530
42339308660000	DOGGETT WENDELL J	PINEHURST	MONTGOME	18531
42339308670000	SABINE CORP	PATRICK P RAY	MONTGOME	18532
42339308690000	WINSLOW	PINEHURST	MONTGOME	18534
42339308710000	DOGGETT WENDELL J	PINEHURST	MONTGOME	18537
42339308720000	CHAMPION UNIT	PATRICK P RAY	MONTGOME	18538
42339308790000	SABINE CORP	PATRICK P RAY	MONTGOME	18547
42339308800000	FRIENDSWOOD	FRIENDSWOOD	MONTGOME	18548
42339308840000	PINEHURST GAS UNIT	PINEHURST	MONTGOME	18554
42339308850000	SABINE CORP NO 3 UNI	PATRICK P RAY	MONTGOME	18555
42339308860000	PINEHURST GAS UNIT	PINEHURST	MONTGOME	18556
42339308870000	PINEHURST GAS UNIT	PINEHURST	MONTGOME	18557
42339308890000	FRIENDSWOOD NO 2 UN	FRIENDSHIP DEV	MONTGOME	18561
42339308900000	MITCHELL GEORGE	FAURE	MONTGOME	18562
42339308950000	FRIENDSWOOD	FRIENDSWOOD	MONTGOME	18570
42339308960000	DOGGETT WENDELL J	PINEHURST	MONTGOME	18571
42339308980000	DAMUTH	PINEHURST	MONTGOME	18574
42339309000000	DULANY	DECKERS PRAIRIE	MONTGOME	18577
42339309010000	MICHEL	DECKERS PRAIRIE S	MONTGOME	18578
42339309020000	WINSLOW LIVING TRUST	TAMINA	MONTGOME	18579
42339309030000	SCHOENFELD	DECKERS PRAIRIE	MONTGOME	18580
42339309050000	SABINE CORP	PATRICK P RAY	MONTGOME	18583
42339309110000	PINEHURST GAS UNIT	PINEHURST	MONTGOME	18590
42339309160000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18597
42339309180000	PINEHURST	PINEHURST	MONTGOME	18599
42339309190000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18602
42339309200000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18604
42339309220000	WILDWOOD ESTATES	PINEHURST	MONTGOME	18607
42339309230000	WINSLOW GAS UNIT `B`	PINEHURST	MONTGOME	18609
42339309250000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18613
42339309270000	GIBSON ESTATE	FRIENDSWOOD	MONTGOME	18615
42339309280000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18616
42339309290000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18617
42339309310000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18620
42339309320000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18621
42339309330000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18623
42339309350000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18625
42339309360000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18627
42339309370000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18628
42339309380000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18631
42339309420000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18636
42339309430000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18637
42339309440000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18638
42339309450000	HAGAN	PINEHURST	MONTGOME	18640
42339309480000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18643

42339309490000	KING R V GU `B`	LAKE CREEK EAST	MONTGOME	18644
42339309500000	MEC/OCONNOR	CARLTON SPEED	MONTGOME	18647
42339309520000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18649
42339309530000	WILDWOOD ESTATES (M/	PINEHURST	MONTGOME	18652
42339309540000	WINSLOW GAS UNIT C	PINEHURST	MONTGOME	18653
42339309550000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18654
42339309570000	BUTLER LILLIE K	LAKE CREEK EAST	MONTGOME	18656
42339309580000	LUCILLE	DECKERS PRAIRIE	MONTGOME	18658
42339309600000	KING R V `A`	LAKE CREEK EAST	MONTGOME	18660
42339309610000	FOSTER MINERALS	WILDCAT	MONTGOME	18661
42339309640000	KEYSTONE MILLS	CONROE SOUTH	MONTGOME	18666
42339309650000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18669
42339309670000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18673
42339309700000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18677
42339309720000	KING R V GU `B`	LAKE CREEK EAST	MONTGOME	18679
42339309770000	CHAMPION PORTER	WILDCAT	MONTGOME	18687
42339309790000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18689
42339309850000	WOMACK	WICKIZER	MONTGOME	18699
42339309860000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	18700
42339309880000	KING R V GU `B`	LAKE CREEK	MONTGOME	18709
42339309890000	COUNTRY COLONY	WILDCAT	MONTGOME	18710
UWI/API	LEASE	FIELD	MONTGOME	18711
42372909313691	TOWNSEND DAVID M SR	WILDCAT	MONTGOME	18722
42373865878282	SHARP CORPORATION	WILDCAT	MONTGOME	18727
42374822442873	ANDERSON	GIDDINGS	MONTGOME	18734
42375779007464	HIGH PRAIRIE RANCH	GIDDINGS	MONTGOME	18741
42376735572055	FITCH UNIT	GIDDINGS	MONTGOME	18744
42377692136646	ANDERSON	GIDDINGS	MONTGOME	18785
42378648701238	BORSKI-PETERS UNIT	GIDDINGS	MONTGOME	18801
42379605265829	MCGRUDER ANDERSON UN	GIDDINGS	MONTGOME	18802
42380561830420	BOYETT LOHNIE	WILDCAT	MONTGOME	18803
42381518395011	ARHOPULOS T J	CLAY NORTHEAST	MONTGOME	18804
42382474959602	MOORE TOM	CLAY NORTHEAST	MONTGOME	18805
42383431524193	MCFARLANE-MOORE UNIT	CLAY NORTHEAST	MONTGOME	18807
42384388088784	KEYSER W B	GIDDINGS	WALLER	18862
42385344653376	LOMETA	GIDDINGS	MONTGOME	18948
42386301217967	MCCULLOUGH A W	GIDDINGS	MONTGOME	18950
42387257782558	ATKINS J M UNIT	GIDDINGS	MONTGOME	18951
42388214347149	FROST	GIDDINGS	MONTGOME	18955
42389170911740	JERICHO-VILAS	CLAY NORTHEAST	MONTGOME	18956
42390127476331	ARHOPULOS-CRENSHAW U	GIDDINGS	MONTGOME	18962
42391084040922	RITCHEY	GIDDINGS	MONTGOME	18981
42392040605514	WHITMORE	GIDDINGS	MONTGOME	19003
42392997170105	DUNLAP-BRYAN UNIT	GIDDINGS	MONTGOME	19008
42393953734696	DUNLAP UNIT	GIDDINGS	MONTGOME	19011
42339018870000	SEALY-SMITH FOUNDATI	WILDCAT	MONTGOME	19013
42339018900000	RL SANDERS ETAL 2-2	WILDCAT	MONTGOME	19016

42339019060000	CENTRAL COAL & COKE	WILDCAT	MONTGOME	19034
42339019070000	SEALY-SMITH	WILDCAT	MONTGOME	19035
42339019110000	RICE UNIVERSITY	WILDCAT	MONTGOME	19039
42339019190000	BRIDGET E WALTON	WILDCAT	MONTGOME	19048
42339019270000	R A WELCHFOUNDATION	WILDCAT	MONTGOME	19055
42339019280000	W D EUNMAN	WILDCAT	MONTGOME	19056
42339019290000	BENDER EST	WILDCAT	MONTGOME	19057
42339019300000	KATHRYN M HINES	WILDCAT	MONTGOME	19058
42339019320000	PANSY E MORRISS UN	WILDCAT	MONTGOME	19059
42339200010000	R PORTER ETAL	WILDCAT	MONTGOME	19104
42339300030000	M&M MINERALS CORP	WILDCAT	MONTGOME	19108
42339300110000	COLEMAN	WILDCAT	MONTGOME	19116
42339300120000	M&M MINERALS CORP	WILDCAT	MONTGOME	19117
42339300150000	KINGWOOD ETAL	WILDCAT	MONTGOME	19120
42339300200000	PEARL EVANS	WILDCAT	MONTGOME	19126
42339300230000	GERTRUDE TIPTON	WILDCAT	MONTGOME	19130
42339300280000	W T HOOPER	WILDCAT	MONTGOME	19134
42339300290000	J SEALY-SMITH FDN 1	WILDCAT	MONTGOME	19136
42339300310000	SOUTH TEXAS DEV	CONROE	MONTGOME	19139
42339300480000	EOLA G FROST ETAL	LAKE CREEK	MONTGOME	19157
42339300490000	KEYSTONE MILLS CO	CONROE	MONTGOME	19158
42339300520000	ERMA YON STREETY	WILDCAT	MONTGOME	19163
42339300610000	SOUTH TEXAS OIL	LAKE CREEK	MONTGOME	19175
42339300720000	SAUNDERS GREGG ETAL	DOBBIN SOUTH	MONTGOME	19182
42339300750000	W A DEAN	PINEHURST	MONTGOME	19185
42339300790000	E G FROST EST	LAKE CREEK	MONTGOME	19188
42339300960000	SOUTH TEXAS DEVELOPM	CONROE	MONTGOME	19203
42339300980000	HAGAN F A	PINEHURST	MONTGOME	19205
42339301010000	FRIENDSWOOD DEV	WILDCAT	MONTGOME	19208
42339301050000	ROBERT KING ETAL	LAKE CREEK	MONTGOME	19210
42339301140000	CHAMPION INTERNATION	WILDCAT	MONTGOME	19220
42339301180000	WOOD /A/	WILDCAT	MONTGOME	19224
42339301280000	MITCHELL	WILDCAT	MONTGOME	19235
42339301330000	WELCH FOUNDTION ETL	WILDCAT	MONTGOME	19239
42339301380000	T E MOSTYN	WILDCAT	MONTGOME	19243
42339301520000	CHAMPION PAPER CO	WILDCAT	MONTGOME	19254
42339301680000	TEX LONG LEAF LMBR	WILDCAT	MONTGOME	19269
42339301720000	J B SYKES	WILDCAT	MONTGOME	19274
42339301860000	MADELEY DAN H	GRAND LAKE	MONTGOME	19286
42339301930000	MADELEY DAN H	GRAND LAKE	MONTGOME	19292
42339301950000	W B INGRAM TR	WILDCAT	MONTGOME	19295
42339301980000	M&M MINERALS/B/	WILDCAT	MONTGOME	19298
42339302020000	FRIENDSWOOD DEV	WILDCAT	MONTGOME	19301
42339302050000	KEYSTONE MILLS	CONROE SOUTH	MONTGOME	19304
42339303860000	FOSTER	CONROE SOUTH	MONTGOME	19314
42339303880000	KEYSTONE MILLS	CONROE SOUTH	MONTGOME	19316
42339303890000	US LAND DEV CORP	GRAND LAKE	MONTGOME	19319

42339303930000	KEYSTONE MILLS	CONROE SOUTH	MONTGOME	19323
42339303990000	KEYSTONE MILLS GU	CONROE SOUTH	MONTGOME	19329
42339304030000	PINEHURST GAS UNIT	PINEHURST	MONTGOME	19338
42339304050000	WOODLANDS DEV CORP	UNNAMED	MONTGOME	19340
42339304130000	HELEN R BICKLE ETAL	CONROE SOUTH	MONTGOME	19353
42339304310000	MOORE H N	CONROE SOUTH	MONTGOME	19373
42339304320000	CHAMPION PAPER CO	LAKE CREEK EAST	MONTGOME	19374
42339304350000	CHAMPION PAPER CO	WILDCAT	MONTGOME	19379
42339304410000	HEINTZ D J /A/	DOBBIN SOUTH	MONTGOME	19388
42339304420000	FRANK R MCWHORTER	WILDCAT	MONTGOME	19389
42339304450000	SABINE CORP	WILDCAT	MONTGOME	19392
42339304550000	FRINDSWOD DEV ET GU	WILDCAT	MONTGOME	19409
42339304810000	BROWN GAS UNIT	TAMINA	MONTGOME	19448
42339304870000	LAWRENCE HENRY	DOBBIN SOUTH	MONTGOME	19455
42339304960000	MCMAHAN M E ETAL	WILDCAT	MONTGOME	19464
42339304990000	BRAUTIGAM ED GU	DECKERS PRAIRIE	MONTGOME	19467
42339305010000	FRIENDSWOOD DEV	FRIENDSHIP DEV	MONTGOME	19472
42339305020000	SABINE CORP	WILDCAT	MONTGOME	19474
42339305040000	GRONINGER LINDA	DOBBIN SOUTH	MONTGOME	19478
42339305050000	MITCHELL GEORGE	WILDCAT	MONTGOME	19479
42339305250000	CHEETAH INC	WILDCAT	MONTGOME	19506
42339305320000	MITCHELL DEV CO	LAKE CREEK NORTH	MONTGOME	19513
42339305330000	CENTRAL COAL & COKE	RAVEN FOREST	MONTGOME	19514
42339305340000	SCHOENFELD	DECKERS PRAIRIE	MONTGOME	19516
42339305400000	REYNOLDS R-BUTLER	LAKE CREEK EAST	MONTGOME	19520
42339305410000	BREED J E GAS UNIT	FRIENDSHIP DEV	MONTGOME	19521
42339305490000	HILL	LAKE CREEK	MONTGOME	19529
42339305530000	CENTRAL COAL & COKE	WILDCAT	MONTGOME	19534
42339305930000	SABINE CORP /ELC/	LAKE CREEK	MONTGOME	19590
42339306000000	EXXON - FRIENDSWOOD	WILDCAT	MONTGOME	19596
42339306040000	FROST EOLA G	LAKE CREEK EAST	MONTGOME	19599
42339306070000	APPLEWHTE ANNA BETH	WILDCAT	MONTGOME	19602
42339306080000	KEYSTONE MILLS	CONROE SOUTH	MONTGOME	19603
42339306090000	KING R V	LAKE CREEK	MONTGOME	19605
42339306120000	PERRY /C/	BENDER	MONTGOME	19609
42339306150000	PECKINPAUGH EST B	PECKINPAUGH	MONTGOME	19611
42339306380000	BENDER ESTATE	SPRING NORTH	MONTGOME	19640
42339306490000	METCALF MARY M	WILDCAT	MONTGOME	19656
42473001990000	W W AINSWORTH ETA	WILDCAT	WALLER	19833
42473002320000	GROCE A J EST	WILDCAT	WALLER	19877
42473002500000	MENKE E P ETAL	RACCOON BEND	WALLER	19898
42473003180000	JOHN W HARRIS ETAL	WILDCAT	WALLER	19982
42473300360000	KATY GAS FIELD UNIT	KATY	WALLER	20068
42473300470000	KATY GAS FIELD UNIT	KATY	WALLER	20087
42473300520000	KATY GAS FIELD UNIT	KATY	WALLER	20092
42473303260000	BULLER LILLIE	WILDCAT	WALLER	20189
42473303330000	MERCANTILE TRUST CO	KATY	WALLER	20197

42473306650000	HARDY RUFUS `B`	RACCOON BEND	WALLER	20555
42473307870000	SCHULZ MARTIN	NORTHSTAR	WALLER	20690
42473308530000	CHAPMAN A	CHAPMAN D3	WALLER	20754
42473308610000	DAVID S D	HOWTH	WALLER	20762
42473308750000	MONTALBANO	HOWTH	WALLER	20776
42473310910000	KATY GFU 2	KATY	WALLER	20998
42473311000000	KATY GFU 2	KATY	WALLER	21007
42473311010000	KATY GAS FIELD CONSO	KATY	WALLER	21008
42473311040000	MOODY-HUTCHINGS	WILDCAT	WALLER	21011
42473311700000	KGFU 1	KATY	WALLER	21079
42473311750000	KGFU 1	KATY	WALLER	21087
42473311800000	KGFU 1	KATY	WALLER	21095
42477304050000	LANDGRAF	SOMERVILLE SOUTH	WASHINGT	21131
42477304340000	JANNER GAS UN	CLAY CREEK	WASHINGT	21159
42477304480000	LOHMEYER LUGENE	WILDCAT	WASHINGT	21171
42477304620000	NEINAST	GIDDINGS	WASHINGT	21187
42477304890000	TRISHA UNIT	GIDDINGS	WASHINGT	21216
42477305270000	YOUNG HARRY E JR	GIDDINGS	WASHINGT	21271
42477305420000	MUTSCHER	GIDDINGS	WASHINGT	21291
42477305440000	WOLFF DAVID	JERRYS QUARTERS	WASHINGT	21296
42477305530000	N ROCKY CREEK PARK	GIDDINGS	WASHINGT	21305
42477305700000	WITT LILLIE	WIND HILL	WASHINGT	21333
42477305830000	BUTLER RANCH /A/	WIND HILL	WASHINGT	21347
42477305840000	WENDT	GIDDINGS	WASHINGT	21348
42477305850000	GUELKER	MELINDA	WASHINGT	21349
42477305970000	B L M	GIDDINGS	WASHINGT	21367
42477306080000	RANTON BLM	GIDDINGS	WASHINGT	21386
42477306090000	THOMAS BLM	GIDDINGS	WASHINGT	21387
42477306100000	LENA B L M	GIDDINGS	WASHINGT	21388
42477306120000	BREDTHAUER	GIDDINGS	WASHINGT	21390
42477306290000	WHIDDON	CHAPPELL HILL	WASHINGT	21415
42477306730000	GIACCONE RALPH	BABY SOUTH	WASHINGT	21457
42477306760000	GOODRICH LEVI	GIDDINGS	WASHINGT	21460
42477306860000	GROTTE H F ETAL	JERRYS QUARTERS	WASHINGT	21476
42477306870000	KLINGSPORN	GIDDINGS	WASHINGT	21480
42477306930000	HAMMANN-NIXON UNIT	GIDDINGS	WASHINGT	21489
42477306950000	KORTH	BRENHAM NORTHWEST	WASHINGT	21491
42477306960000	NEINAST-JOHNSTON UNI	GIDDINGS	WASHINGT	21493
42477307500000	LEACHMAN UNIT	GIDDINGS	WASHINGT	21626
42477307520000	SOMMER OL	GIDDINGS	WASHINGT	21631
42477307580000	HARDY STAR	GIDDINGS	WASHINGT	21640
42477307660000	MCGINNES UNIT	GIDDINGS	WASHINGT	21656
42477307710000	TAPPE UNIT	NAVASOTA RIVER	WASHINGT	21670
42477307720000	KANKEL	GIDDINGS	WASHINGT	21675
42477307770000	NEWMAN	GIDDINGS	WASHINGT	21689
42477307940000	BLASINGAME	GIDDINGS	WASHINGT	21743

42477307960000	LOESCH OL	GIDDINGS	WASHINGT	21747
42477000070000	DUPREE BEN	WILDCAT	WASHINGT	21901
42477002170000	H LAUTER ETAL	CLAY CREEK	WASHINGT	22134
42477002190000	LAUTER H	CLAY CREEK	WASHINGT	22136
42477002370000	QUEBE EMMA	ARTHUR HARVEY	WASHINGT	22156
42477002380000	FRED DALLAS	ARTHUR HARVEY	WASHINGT	22157
42477002400000	CLAY	CLAY CREEK	WASHINGT	22159
42477002420000	NETTIE ANDERSON	CLAY CREEK	WASHINGT	22161
42477002450000	SEWARD O A	WILDCAT	WASHINGT	22164
42477002560000	TATE G W ETAL	WILDCAT	WASHINGT	22176
42477002590000	BOHNE W C	WILDCAT	WASHINGT	22179
42477002600000	BUCK H C	WILDCAT	WASHINGT	22180
42477002750000	SHAVER MARY R	WILDCAT	WASHINGT	22197
42477002760000	SCHROEDER FRITZ Y	WILDCAT	WASHINGT	22198
42477002780000	ARNOLD LAMMERT	WILDCAT	WASHINGT	22201
42477003650000	SOLOMAN ETAL LEEROY	WILDCAT	WASHINGT	22295
42477003660000	A MAKOWSKY	WILDCAT	WASHINGT	22296
42477004250000	HENRY QUEBE	ARTHUR HARVEY	WASHINGT	22354
42477300520000	FREE-ANDERSON UNIT	BRENHAM	WASHINGT	22430
42477302930000	F A LIDDELL	WILDCAT	WASHINGT	22456
42477302940000	DAVID C BINTLIFF ET	WILDCAT	WASHINGT	22457
42477303050000	DRAGGER&MAYSEL ETAL	CLAY CREEK	WASHINGT	22468
42477303270000	ROSENBAUM IDA	CLAY CREEK	WASHINGT	22499
42477303400000	JOHNSTON	GIDDINGS	WASHINGT	22519
42477303650000	KOETHER	GIDDINGS	WASHINGT	22535
42477303670000	JAMESON ROBERT D	OXBOW D3	WASHINGT	22539
42477303800000	OEVERMANN UNIT	GIDDINGS	WASHINGT	22553
42477303820000	KUNKEL-MUELLER UNIT	GIDDINGS	WASHINGT	22555
42477303840000	PITTS HUGH	GIDDINGS	WASHINGT	22558
42477303900000	FIVE STAR RANCH	GIDDINGS	WASHINGT	22565
42477303980000	HARDING HARMEL	GIDDINGS	WASHINGT	22578
42477304020000	TOMACHEFSKY UNIT	GIDDINGS	WASHINGT	22588
42477308410000	BOSSE	GIDDINGS	WASHINGT	22605
42477308830000	DIVIN UNIT	WILDCAT	WASHINGT	22682
42477309060000	MAC ARTHUR UNIT	GIDDINGS	WASHINGT	22730
42477309220000	TRAMMELL	WILDCAT	WASHINGT	22753
42477309270000	TRAMMELL	CHAPMAN	WASHINGT	22759
42477309460000	LANDERS	WILDCAT	WASHINGT	22786
42201324510000	LONGENBAUGH ALTA G E	CYPRESS DEEP	HARRIS	25040
42201325740000	JOSEY RANCH GU 3	CYPRESS DEEP	HARRIS	25180
42201325770000	HARMS	MILTON WEST	HARRIS	25183
42201325820000	JOSEY RANCH GAS UNIT	CYPRESS DEEP	HARRIS	25191
42201325850000	EHRHARDT JOHN (WILCO	MILTON NORTH	HARRIS	25194
42201325870000	WALKER	WILDCAT	HARRIS	25195
42201325890000	BURNET BAY	WILDCAT	HARRIS	25198
42201325970000	SWEENEY GAS UNIT 1	MILTON NORTH	HARRIS	25206
42201326000000	JOSEY RANCH GAS UNIT	LANGHAM CREEK	HARRIS	25213

42201326160000	BAHR INTEREST ETAL U	CROSS CREEK	HARRIS	25237
42201326240000	CARROLL	INDIAN HILLS	HARRIS	25247
42201326630000	JOSEY RANCH GAS UNIT	CYPRESS DEEP	HARRIS	25295
42201326650000	ADAMS G UNIT	TOMBALL	HARRIS	25297
42201326780000	BUNDICK	DYERSDALE	HARRIS	25310
42201326900000	TRESSLER	TOMBALL	HARRIS	25322
42201326960000	JOSEY KATHLEEN	DELHI NORTH	HARRIS	25327
42201327080000	MARSHALL BROTHERS TR	TOMBALL SOUTHEAST	HARRIS	25339
42201327780000	JOSEY RANCH GAS UNIT	CYPRESS DEEP	HARRIS	25415
42201327830000	SWILLEY	VICTOR BLANCO	HARRIS	25420
42201328110000	ALTA	WILDCAT	HARRIS	25450
42201328420000	BAILEY WELDON D ET A	WILDCAT	HARRIS	25480
42339000040000	CENTRAL COAL & COKE	WILDCAT	MONTGOME	25644
42339000050000	CENTRAL COAL & COKE	WILDCAT	MONTGOME	25645
42339000060000	COKE /A/	UNNAMED	MONTGOME	25646
42339000130000	FOSTER LUMBER	WILDCAT	MONTGOME	25653
42339000150000	FOSTER LUMBER /B/	FOSTORIA	MONTGOME	25655
42339000160000	FOSTER LUMBER	FOSTORIA	MONTGOME	25656
42339000170000	FOSTER-BRUCE UNIT	FOSTORIA	MONTGOME	25657
42339000180000	R R TODD ETAL	FOSTORIA	MONTGOME	25658
42339000210000	FOSTER LUMBER UNT D	FOSTORIA	MONTGOME	25661
42339000220000	GODE JOHN UNIT /A/	FOSTORIA	MONTGOME	25662
42339000230000	FOSTER LUMBER 1C1	FOSTORIA	MONTGOME	25664
42339000240000	FOSTER LUMBER	FOSTORIA	MONTGOME	25665
42339000250000	BURKETT UNIT	FOSTORIA	MONTGOME	25668
42339000330000	FOSTER-GULF	FOSTORIA	MONTGOME	25676
42339000340000	FOSTER LBR	FOSTORIA	MONTGOME	25678
42339000350000	SOUTLAND PAPER MILL	FOSTORIA	MONTGOME	25679
42339000450000	FRASER W B	WILDCAT	MONTGOME	25689
42339000500000	FOSTER ESTATE	WILDCAT	MONTGOME	25694
42339000510000	BROWDER J G	WILDCAT	MONTGOME	25696
42339000630000	WILLIS T/S UNIT 1	WILDCAT	MONTGOME	25708
42339000640000	TODD JOHN	WILDCAT	MONTGOME	25709
42339000660000	ROSE K G	WILDCAT	MONTGOME	25711
42339000670000	HUTCHNGS-SELY NT BK	WILDCAT	MONTGOME	25712
42339000680000	HUTCHINS-SEALY	WILDCAT	MONTGOME	25713
42339000690000	HUTCHINGS-SEALY N B	WILDCAT	MONTGOME	25714
42339000760000	HUTCHINGS SEALY NAT	CONROE NORTH	MONTGOME	25725
42339000770000	SEALY TRUSTEE GEO	WILDCAT	MONTGOME	25726
42339000800000	HUTCHINS-SEALY NATB	CONROE NORTH	MONTGOME	25729
42339000870000	GAS UNIT #2	CONROE NORTH	MONTGOME	25736
42339000900000	FOWLER CHAMP	WILDCAT	MONTGOME	25739
42339000910000	DARDEN-BYBEE UNIT	WILDCAT	MONTGOME	25740
42339000970000	C L ANDERSON	WILDCAT	MONTGOME	25746
42339007280000	W M WILLIAMS	CONROE	MONTGOME	26263
42339007600000	SOUTH TEXAS DEV	CONROE	MONTGOME	26321

42339008570000	SAN JACINTO TRUST	WILDCAT	MONTGOME	26569
42339001980000	GRAND LAKE OIL	GRAND LAKE	MONTGOME	26615
42339002020000	G LAKE GAS UNT 2	GRAND LAKE	MONTGOME	26620
42339005010000	WM RICE INSTITUTE	WILDCAT	MONTGOME	27238
42339008780000	T W ELAM	WILLIS D3	MONTGOME	27266
42339008950000	GOFF AMANDA ETAL	WILDCAT	MONTGOME	27285
42339008960000	P JONES	WILDCAT	MONTGOME	27286
42339009050000	TEAS NURSERY CO	WILDCAT	MONTGOME	27296
42339009060000	TEAS NURSERY	WILDCAT	MONTGOME	27297
42339009330000	MCCLENDON S JR ETAL	WILDCAT	MONTGOME	27329
42339009390000	E G FROST	LAKE CREEK	MONTGOME	27335
42339009400000	FROST E G ETAL	LAKE CREEK	MONTGOME	27337
42339009420000	SEALY-SMITH	GRAND LAKE	MONTGOME	27340
42339009430000	SEALY-SMITH FNDTN	LAKE CREEK EAST	MONTGOME	27341
42339009540000	WYSINGER ETUX W S	WILDCAT	MONTGOME	27354
42339009630000	MADELEY DON H	WILDCAT	MONTGOME	27363
42339009640000	CENTRAL COAL & COKE	WILDCAT	MONTGOME	27364
42339009700000	PEEL T J	WILDCAT	MONTGOME	27370
42339009730000	ALLIANCE TRUST COMPA	WILDCAT	MONTGOME	27373
42339009750000	PEEL T J	WILDCAT	MONTGOME	27375
42339009770000	SEALY & SMITH	WILDCAT	MONTGOME	27377
42339009870000	W M WILLIAMS	LAKE CREEK	MONTGOME	27388
42339009880000	J T BERTRARD	LAKE CREEK	MONTGOME	27389
42339009960000	J B MARTIN TR	WILDCAT	MONTGOME	27397
42339010040000	SHANDS & W T JONES	WILDCAT	MONTGOME	27408
42339010080000	SEYLE ROSCOE	MAGNOLIA	MONTGOME	27412
42339010090000	TUCKER H T ETAL	WILDCAT	MONTGOME	27413
42339010100000	SOUTH TEXAS DEV CO	WILDCAT	MONTGOME	27414
42339010150000	MCCRABB J F	WILDCAT	MONTGOME	27419
42339010180000	MCWHORTER T A	LAKE CREEK	MONTGOME	27422
42339010220000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27427
42339010230000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27429
42339010280000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27438
42339010290000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27440
42339010300000	T A MCWHORTER	LAKE CREEK	MONTGOME	27441
42339010320000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27448
42339010350000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27453
42339010360000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27455
42339010370000	C A DAMUTH ETAL	LAKE CREEK	MONTGOME	27456
42339010400000	WINSLOW J M	LAKE CREEK	MONTGOME	27461
42339010510000	PINEHURST UNIT	PINEHURST	MONTGOME	27475
42339010520000	PINEHURST UNIT	PINEHURST	MONTGOME	27478
42339010530000	PINEHURST UNIT	PINEHURST	MONTGOME	27481
42339010540000	PINEHURST UNIT	PINEHURST	MONTGOME	27483
42339010550000	DEAN W A ETAL	PINEHURST	MONTGOME	27485
42339010560000	W A DEAN ETAL	PINEHURST	MONTGOME	27488
42339010570000	GROGAN-COCHRAN LBR	PINEHURST	MONTGOME	27489

42339010580000	STREETY ERMA YON	WILDCAT	MONTGOME	27490
42339010590000	STREETY ERMA YON	WILDCAT	MONTGOME	27491
42339010600000	M A DEAN ETAL UN	WILDCAT	MONTGOME	27492
42339010610000	HEFLIN JULIA L	WILDCAT	MONTGOME	27493
42339010620000	L L KRAMER ETAL	WILDCAT	MONTGOME	27495
42339010630000	KRAMER ETAL L N	PINEHURST WEST	MONTGOME	27496
42339010790000	PITTS & LYLES	WILDCAT	MONTGOME	27512
42339010830000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27517
42339010840000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27518
42339010850000	BROWNE HOMER	LAKE CREEK	MONTGOME	27520
42339010860000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27522
42339010880000	SOUTH TEXAS DEV	LAKE CREEK	MONTGOME	27527
42339010890000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27532
42339010900000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27533
42339010920000	SOUTH TEXAS DEVELOPM	LAKE CREEK	MONTGOME	27539
42339010930000	LAKE CREEK UNIT	LAKE CREEK	MONTGOME	27541
42339010940000	H M MCMAHAN	LAKE CREEK	MONTGOME	27542
42339010950000	M & M MINERALS CORP	LAKE CREEK	MONTGOME	27543
42339011070000	M M NUTTER	TAMINA	MONTGOME	27555
42339011080000	MINNIE MIXON	TAMINA	MONTGOME	27556
42339011090000	INA ARCENAUX	TAMINA	MONTGOME	27557
42339011100000	MCMAHAN H M	WILDCAT	MONTGOME	27558
42339011110000	H M MCMAHAN ETAL	WILDCAT	MONTGOME	27559
42339011120000	J R WINSLOW	TAMINA	MONTGOME	27561
42339011140000	H A BUDDE	WILDCAT	MONTGOME	27563
42339011310000	CHASE MANHATTAN	INDIAN HILLS N	MONTGOME	27580
42339012250000	KROHN P G `B`	CONROE	MONTGOME	27700
42339015550000	S TEX DEV	CONROE	MONTGOME	28326
42339016040000	SOUTH TEXAS DEV CO	WILDCAT	MONTGOME	28431
42339017130000	D ANDERSON ETAL UN	WILDCAT	MONTGOME	28587
42339017170000	A W SCHWING	WILDCAT	MONTGOME	28594
42339017180000	WICKIZER WILLARD M	WILDCAT	MONTGOME	28595
42339017360000	BENDER E L ETAL	WILDCAT	MONTGOME	28614
42339017390000	BENDER ESTATE FARM	WILDCAT	MONTGOME	28617
42339017990000	SOUTHLAND PAPER MILL	SPLENDORA SOUTH	MONTGOME	28689
42339018020000	TEX LONG LEAF LBR	WILDCAT	MONTGOME	28692
42339018030000	L L NEFF	WILDCAT	MONTGOME	28694
42339018040000	L L NEFF	SPLENDORA SOUTH	MONTGOME	28695
42339018120000	SOUTHERLAND PAPER	SPLENDORA SW	MONTGOME	28768
42039329910000	PATTERSON	PLEASANT BAYOU	BRAZORIA	32398
42041000090000	H L WEEDON	WILDCAT	BRAZOS	32636
42041000110000	A MCCULLOUGH ETAL	FERGUSON CROSSING	BRAZOS	32638
42041000120000	R P TRANT	WILDCAT	BRAZOS	32639
42041000170000	C S BECKWITH	WILDCAT	BRAZOS	32644
42041000260000	CREED R ETAL	WILDCAT	BRAZOS	32653
42041000370000	J A ARHOPULOS	WILDCAT	BRAZOS	32664

42041000390000	JOHN A ARHOPULOS	WILDCAT	BRAZOS	32666
42041000400000	PRESCOTT P R	MILLICAN DOME	BRAZOS	32667
42041000410000	P P PRESCOTT	WILDCAT	BRAZOS	32668
42041000420000	MOORE H H	MILLICAN DOME	BRAZOS	32669
42041000430000	H H MOORE	WILDCAT	BRAZOS	32670
42041000450000	MOORE & HOLT	MILLICAN DOME	BRAZOS	32672
42041000460000	WHARTON WEEMS	MILLICAN DOME	BRAZOS	32673
42041000470000	MRS M E MITCHELL	WILDCAT	BRAZOS	32674
42041000480000	WEEMS WHARTON	MILLICAN DOME	BRAZOS	32675
42041000500000	HELEN LEGRAND	MILLICAN DOME	BRAZOS	32677
42041000510000	PATTERSON PAT	MILLICAN DOME	BRAZOS	32678
42041000520000	S E DUNLOP	MILLICAN DOME	BRAZOS	32679
42041000550000	WILLIAMS LENA	MILLICAN DOME	BRAZOS	32682
42041000560000	WILLIAMS KNOX	WILDCAT	BRAZOS	32683
42041000600000	LENA WILLIAMS	MILLICAN EAST	BRAZOS	32687
42041000630000	LOUISE ORLANDO	WILDCAT	BRAZOS	32690
42041000660000	SCHOEPS FANNIE	WILDCAT	BRAZOS	32693
42041000680000	D B SCHOEPS	MILLICAN DOME	BRAZOS	32695
42041000740000	MC GREGOR C B	MILLICAN DOME	BRAZOS	32703
42041000750000	B L FANNETTE	MILLICAN DOME	BRAZOS	32704
42041000770000	ANNE BIRD RENCHIE	MILLICAN DOME	BRAZOS	32706
42041000790000	DONA HOLLOWAY	MILLICAN DOME	BRAZOS	32708
42041000800000	R C DUNN	WILDCAT	BRAZOS	32709
42041000820000	KEYSER W B	MILLICAN EAST	BRAZOS	32711
42041000830000	BURROWS VIOLA	WILDCAT	BRAZOS	32712
42041000840000	ALLEN & CLAY	WILDCAT	BRAZOS	32713
42041000850000	BLANTON H M	WILDCAT	BRAZOS	32714
42041000870000	LOUIS ORLANDO EST	WILDCAT	BRAZOS	32716
42041000880000	W C MITCHELL	WILDCAT	BRAZOS	32718
42041000940000	O E KEYSER	MILLICAN EAST	BRAZOS	32725
42041000980000	KEYSER-TURNER UNIT	MILLICAN EAST	BRAZOS	32729
42041001030000	DUNLAP S E	MILLICAN DOME	BRAZOS	32734
42041300030000	KEYSER-BOYETT UN	MILLICAN EAST	BRAZOS	32739
42041300050000	WEEMS EST ET AL	MILLICAN DOME	BRAZOS	32741
42041300070000	P P PRESCOTT	MILLICAN DOME	BRAZOS	32744
42041300210000	WEEMS ESTATE ETAL	MILLICAN DOME	BRAZOS	32757
42041300230000	CALVIN ROSS ETAL A	MILLICAN DOME	BRAZOS	32760
42041300580000	BARKER INA MAE	MILLICAN DOME	BRAZOS	32788
42041300610000	INA MAE BARKER	MILLICAN DOME	BRAZOS	32790
42041300720000	A W MC CULLOUGH	FERGUSON CROSSING	BRAZOS	32804
42041300740000	LANG UNIT	KURTEN	BRAZOS	32806
42041303250000	O J TAUBER	KURTEN	BRAZOS	32828
42041303840000	C W SCHROEDER	WILDCAT	BRAZOS	32891
42041303900000	DAVID S CARRABBA	WILDCAT	BRAZOS	32898
42041304100000	K M MORRIS	WILDCAT	BRAZOS	32918
42041304730000	PALASOTA PETE J	KURTEN	BRAZOS	32987

42041304800000	STASNY W A	CALDWELL	BRAZOS	32997
42041304810000	BROACH R R	CALDWELL	BRAZOS	32998
42041304920000	MOORE TOM J LEASE	WILDCAT	BRAZOS	33011
42041305210000	WATSON LILLY CARLL	GIDDINGS	BRAZOS	33048
42041305270000	MOORE ROBERT	CLAY NORTHEAST	BRAZOS	33055
42041305500000	GUEST CALVIN	KURTEN	BRAZOS	33090
42041305520000	WALKER M P	MULLIGAN NE	BRAZOS	33092
42041305570000	PATE SAM B UNIT	KURTEN	BRAZOS	33097
42041305610000	WADE	WELLBORN SOUTH	BRAZOS	33104
42041305660000	OPERSTENY UNIT II	KURTEN	BRAZOS	33113
42041305830000	JOHNSON WILLIAM	WELLBORN SOUTH	BRAZOS	33133
42041306020000	MCSWAIN /A/	GIDDINGS	BRAZOS	33157
42041306060000	CREAGOR D C /B/	GIDDINGS	BRAZOS	33162
42041306070000	FUCHS B J UNIT	WHEELOCK	BRAZOS	33163
42041306150000	RIET VAN	WELLBORN	BRAZOS	33171
42041306210000	WINDHAM /A/	GIDDINGS	BRAZOS	33182
42041306220000	THOMPSON-SPRINGFILD	GIDDINGS	BRAZOS	33183
42041306380000	EIDSON /A/ UNIT	GIDDINGS	BRAZOS	33198
42041306680000	FREEMAN-CLARK	GIDDINGS	BRAZOS	33229
42041307020000	MCCULLOUGH UNIT	MAPLE LEAF	BRAZOS	33267
42041307040000	GRAY	KURTEN	BRAZOS	33273
42041307100000	CONNOR-WHELLER UNIT	KURTEN	BRAZOS	33283
42041307110000	ANDERSON F	GIDDINGS	BRAZOS	33286
42041307250000	STEPHEN S	GIDDINGS	BRAZOS	33306
42041307550000	TRIOLA	KURTEN	BRAZOS	33343
42041307770000	LYONS FEE UNIT II	BRYAN	BRAZOS	33378
42041307840000	WHEELER B	BRYAN	BRAZOS	33385
42041307930000	GREEN GEORGE	GIDDINGS	BRAZOS	33401
42041307980000	LESTER JACK	KURTEN	BRAZOS	33408
42041308070000	RABORN J C	BRYAN	BRAZOS	33419
42041308080000	MIDWEST VIDEO UN 1	KURTEN	BRAZOS	33421
42041308130000	LYONS FEE UNIT III	BRYAN	BRAZOS	33430
42041308370000	ALLEN UNIT	BRYAN	BRAZOS	33462
42041308570000	SMITH SHARON UNIT	BRYAN	BRAZOS	33486
42041308660000	NUNN WALTER UNIT	BRYAN	BRAZOS	33501
42041308810000	SMITH NORMA UNIT	BRYAN	BRAZOS	33520
42041309360000	T A M U S TR A	BRYAN	BRAZOS	33586
42041309870000	GREEN JAMES	WILDCAT	BRAZOS	33657
42041310440000	COX UNIT I	IOLA SOUTH	BRAZOS	33725
42041310790000	LESTER UNIT	BRYAN	BRAZOS	33776
42041310820000	CASHION M L	WILDCAT	BRAZOS	33780
42041310980000	KRUSE	AGGIELAND	BRAZOS	33798
42041311140000	MURPHY UNIT	AGGIELAND	BRAZOS	33816
42041311220000	MIKESKA	WELLBORN	BRAZOS	33825
42041311250000	GORZYCKI	AGGIELAND	BRAZOS	33829
42041312190000	VALLEY RIDGE UN	AGGIELAND	BRAZOS	33963
42041312380000	PEARSON W S ETAL	AGGIELAND	BRAZOS	33988

42041312540000	GAMBLE P K ET AL	AGGIELAND	BRAZOS	34012
42041312650000	TAKASKI	AGGIELAND	BRAZOS	34026
42041314480000	BRADLEY UNIT	AGGIELAND	BRAZOS	34286
42041314490000	TERRELL FARMS	CLAY NORTHEAST	BRAZOS	34287
42041314550000	RUFFINO PRESTON /B/	KURTEN	BRAZOS	34292
42041314790000	KURTEN WOODBINE UN	KURTEN	BRAZOS	34342
42041314800000	KURTEN WOODBINE UN	KURTEN	BRAZOS	34343
42041314910000	KURTEN WOODBINE UNIT	KURTEN	BRAZOS	34362
42041315060000	CONLEE	GIDDINGS	BRAZOS	34390
42041315160000	CONLEE	GIDDINGS	BRAZOS	34408
42041315250000	KURZ	GIDDINGS	BRAZOS	34422
42041315350000	CONLEE UNIT	GIDDINGS	BRAZOS	34451
42041315410000	CARGILL	GIDDINGS	BRAZOS	34467
42041315640000	WINTERSHALL-ARHOPULO	GIDDINGS	BRAZOS	34524
42041315810000	CARTER	GIDDINGS	BRAZOS	34553
42051316790000	SCHMIDT	GIDDINGS	BURLESON	34568
42051316880000	VAJDAK H /A/	GIDDINGS	BURLESON	34577
42051317990000	LASTLY JAMES	SOMERVILLE	BURLESON	34707
42051318690000	LEWIS H C UNIT	GIDDINGS	BURLESON	34782
42051319440000	SLOVACEK O J	GIDDINGS	BURLESON	34866
42051319460000	BLACK C M UN	GIDDINGS	BURLESON	34868
42051319790000	BLAHA C H UNIT	GIDDINGS	BURLESON	34905
42051320060000	BLAHA C H /A/ UN	GIDDINGS	BURLESON	34933
42051320110000	WOMBLE NADA	GIDDINGS	BURLESON	34938
42051320120000	CONNELL M S UN	GIDDINGS	BURLESON	34939
42051320130000	BALKE I	GIDDINGS	BURLESON	34941
42051320230000	KEY LEONARD	NOACK COW HERD	BURLESON	34953
42051320480000	BLACKJACK PLACE	GIDDINGS	BURLESON	34976
42051320890000	SEALY-SMITH UNIT	GIDDINGS	BURLESON	35023
42051321000000	DORA	GIDDINGS	BURLESON	35036
42051321260000	TATAM LESTER L	CALDWELL	BURLESON	35064
42051321400000	SETTEGAST OPERATONS	GIDDINGS	BURLESON	35079
42051321410000	SEALY-SMITH UNIT	GIDDINGS	BURLESON	35080
42051321710000	SEALY-SMITH UNIT	GIDDINGS	BURLESON	35110
42051321970000	FARMER	HOOKER CREEK	BURLESON	35138
42051322450000	KRENEK J UNIT	GIDDINGS	BURLESON	35192
42051322840000	BLAHA C H /B/	GIDDINGS	BURLESON	35231
42051323010000	O D C	GIDDINGS	BURLESON	35253
42051323300000	HAZARD	GIDDINGS	BURLESON	35285
42051323340000	LOCKHART UNIT	BIG -A- TAYLOR	BURLESON	35289
42051324110000	SANTA FE /B/	GIDDINGS	BURLESON	35363
42051324200000	SANTA FE `A`	GIDDINGS	BURLESON	35376
42051324600000	WEST BIRCH CRK PARK	GIDDINGS	BURLESON	35417
42051327520000	LAUDERDALE	GIDDINGS	BURLESON	35733
42051327530000	LAUDERDALE	GIDDINGS	BURLESON	35734
42051327810000	LAUDERDALE	GIDDINGS	BURLESON	35766
42051328900000	LEWIS B L M	GIDDINGS	BURLESON	35900

42051329930000	MCMILLAN	JERRYS QUARTERS	BURLESON	36017
42051330850000	WOMBLE NADA UNIT	GIDDINGS	BURLESON	36140
42051330880000	GIESENSCHLAG W H (I)	GIDDINGS	BURLESON	36143
42051331230000	SCHRADER L R UNIT	GIDDINGS	BURLESON	36200
42051331570000	BALKE I UNIT	GIDDINGS	BURLESON	36248
42051332810000	SCARMARDO-MARYLINDA	GIDDINGS	BURLESON	36445
42051333340000	WILKINS MABEL	CLAY NORTHEAST	BURLESON	36536
42051333520000	PECORE-SIEGERT	CLAY NORTHEAST	BURLESON	36565
42051333650000	SMITH SEALY UNIT	GIDDINGS	BURLESON	36592
42051334050000	HUTCHINGS-HUTCHINGS	CLAY NORTHEAST	BURLESON	36678
42051334080000	QUEBE UNIT	GIDDINGS	BURLESON	36688
42051334320000	BARNHART W T UNIT	GIDDINGS	BURLESON	36752
42051335740000	BECVAR-WATSON UNIT	HOOKER CREEK	BURLESON	37027
42051336030000	BECVAR ALBERT	HOOKER CREEK	BURLESON	37092
42051336250000	BEHRENDS	WILLARD SOUTHEAST	BURLESON	37136
42051336530000	NEAL	WILLARD	BURLESON	37194
42157300370000	FOSTER FARMS	WILDCAT	FORT BEN	38824
42157304010000	J M MOORE ETAL	MOORES ORCHARD	FORT BEN	39228
42157311520000	FUQUA INDUSTRIES	WILDCAT	FORT BEN	39620
42157313990000	COOLEY DENTON A	COOLEY	FORT BEN	39865
42157315290000	ZDUNKAWICZ ANNA MEEK	COOLEY	FORT BEN	40029
42157316720000	HIGHLANDS MGMT	WILDCAT	FORT BEN	40204
42157317290000	SANDERS L J	COOLEY	FORT BEN	40274
42157317300000	MOORE J M ETAL	MOORES ORCHARD	FORT BEN	40275
42157317650000	HARRISON RANCH	WILDCAT	FORT BEN	40321
42157317900000	TOWNSITE	COOLEY	FORT BEN	40351
42157318270000	GRIGAR	COOLEY	FORT BEN	40395
42167314290000	HALLS BAYOU RANCH A	GREENS LAKE	GALVESTO	42991
42185000020000	YEAGER J P	WILDCAT	GRIMES	43086
42185000040000	NEELY ESTATE	WILDCAT	GRIMES	43088
42185000060000	HARRISON B MRS	WILDCAT	GRIMES	43090
42185000170000	J PRICE GAS UT I	MADISON GAS FD	GRIMES	43104
42185000190000	FANNIE UPCHURCH	WILDCAT	GRIMES	43106
42185000220000	STONE L E	WILDCAT	GRIMES	43110
42185000240000	WILSON MATTIE F	WILDCAT	GRIMES	43112
42185000250000	FRANKOW JOHN L	WILDCAT	GRIMES	43113
42185000260000	DODD L	WILDCAT	GRIMES	43114
42185000330000	BRADLEY I P	WILDCAT	GRIMES	43121
42185000350000	H A BENNETT	WILDCAT	GRIMES	43123
42185000360000	COCKRELL JR ERNEST	WILDCAT	GRIMES	43124
42185000370000	BROWN W S ETAL	WILDCAT	GRIMES	43125
42185000380000	THOMAS PAUL & WM	WILDCAT	GRIMES	43126
42185000420000	TRANT R P	FERGUSON CROSSING	GRIMES	43132
42185000440000	TRANT R P NCT 1	FERGUSON CROSSING	GRIMES	43134
42185000500000	SEALY GEO TRUSTEE	WILDCAT	GRIMES	43140

42185000610000	FREUND ESTATE	CARLOS	GRIMES	43151
42185000690000	MOODY W E	WILDCAT	GRIMES	43160
42185000750000	BRIGANCE ESTATE	WILDCAT	GRIMES	43166
42185000760000	PERRY E O	WILDCAT	GRIMES	43167
42185000790000	ROBERT FOSTER	WILDCAT	GRIMES	43171
42185000800000	R C DAVIS JR	WILDCAT	GRIMES	43172
42185000830000	J T BARRY	WILDCAT	GRIMES	43177
42185000850000	HARRIS E L	WILDCAT	GRIMES	43179
42185000870000	HARRIS E L	WILDCAT	GRIMES	43182
42185000980000	QUINN J M	WILDCAT	GRIMES	43193
42185001100000	GAYLE W	WILDCAT	GRIMES	43207
42185001110000	GOFORTH E G FEE	WILDCAT	GRIMES	43208
42185001120000	E G GOFORTH	PELTERVILLE SOUTH	GRIMES	43209
42185001170000	E R SANDERS	RETREAT	GRIMES	43214
42185001210000	IRIS CLARK	HOPEWELL	GRIMES	43218
42185001220000	HARRIS JOHN ETAL	WILDCAT	GRIMES	43219
42185001270000	RUTH CUTHRELL	CARLOS	GRIMES	43225
42185001280000	FLORA I JOHNSON	WILDCAT	GRIMES	43227
42185001340000	HEIRS OF G E SIDDAL	WILDCAT	GRIMES	43234
42185001460000	REA & BRACEWELL	WILDCAT	GRIMES	43246
42185001470000	J C CHANEY	WILDCAT	GRIMES	43247
42185300020000	M D NEVILLE	WILDCAT	GRIMES	43258
42185300070000	GARRETT UN #1	MADISONVILLE S	GRIMES	43263
42185300100000	H RUCKER OIL UN 1	WILDCAT	GRIMES	43267
42185300210000	HOWELL-ASHBURN	FERGUSON CROSSING	GRIMES	43278
42185300260000	HUNTER B A	WILDCAT	GRIMES	43283
42185300270000	FANNIE UPCHURCH	WILDCAT	GRIMES	43284
42185300280000	W A BEVANS	BEVANS RANCH	GRIMES	43286
42185300290000	E L DYER	WILDCAT	GRIMES	43287
42185300340000	WILLIAM GARDNER	RETREAT	GRIMES	43293
42185300380000	OLA H GARRETT	WILDCAT	GRIMES	43298
42185300420000	MIZE R H	WILDCAT	GRIMES	43301
42185300430000	HOMER F LEIFESTE	WILDCAT	GRIMES	43303
42185300440000	PHILIO HEIRS	HOPEWELL	GRIMES	43304
42185300450000	SAM B HARRISON	BEDIAS WEST	GRIMES	43305
42185300490000	MARSH /A/	WILDCAT	GRIMES	43310
42185300520000	UPCHURCH FANNIE	IOLA	GRIMES	43313
42185300530000	FANNIE UPCHURCH	WILDCAT	GRIMES	43314
42185300580000	BUTLER /B/	PLANTERSVILLE	GRIMES	43319
42185300600000	J WGILPIN-GA DIRKS	WILDCAT	GRIMES	43321
42185300660000	D M WRIGHT	IOLA	GRIMES	43327
42185300970000	J C HOWARD	WILDCAT	GRIMES	43334
42015000030000	POLSCHAK E	WILDCAT	AUSTIN	49153
42015000050000	ZANDER	WILDCAT	AUSTIN	49155
42015000160000	EBEN EMMA	WILDCAT	AUSTIN	49166
42015000210000	VON ROSENBERG	WILDCAT	AUSTIN	49173

42015000220000	R E BEAMAN	WILDCAT	AUSTIN	49174
42015000230000	FRANK MIKESKA	WILDCAT	AUSTIN	49175
42015000240000	WILLIAM M WRIGHT	WILDCAT	AUSTIN	49176
42015002430000	MEWIS A E & C F	WILDCAT	AUSTIN	49543
42015002560000	ALVIN KONESCHECK	SEALY	AUSTIN	49557
42015002610000	D C HILLBOLDT	SEALY	AUSTIN	49563
42015002690000	COLE GAS UNIT 1	SEALY	AUSTIN	49574
42015002720000	KULOW-BIELEFELD UNT	WILDCAT	AUSTIN	49578
42015003730000	PAINE ROBERT G	RACCOON BEND	AUSTIN	49774
42015005140000	AUSTIN COLLEGE	RACCOON BEND	AUSTIN	50025
42015005660000	EBEN	NEW ULM	AUSTIN	50092
42015005710000	R HOPPE	NEW ULM	AUSTIN	50097
42015005990000	LESIKAR-BUNDY UNIT	NEW ULM	AUSTIN	50141
42015006150000	MARVIN KLOSTERMANN	WILDCAT	AUSTIN	50167
42015006170000	ARMOND DOLESHAL	NELSONVILLE	AUSTIN	50169
42015006270000	TOM BRAVENEC	NELSONVILLE	AUSTIN	50195
42015006460000	HUBER HENRY	WILDCAT	AUSTIN	50222
42015006510000	OTTO SEVERIN	MILHEIM	AUSTIN	50228
42015006570000	HUBER LAWRENCE	WILDCAT	AUSTIN	50234
42015006580000	BATLE ETAL ED	WILDCAT	AUSTIN	50235
42015006600000	GOEBEL REINHOLD	WILDCAT	AUSTIN	50237
42015006630000	KOLLOTSCHNY PAUL	WILDCAT	AUSTIN	50240
42015006780000	MILLER HEDWIG	WILDCAT	AUSTIN	50257
42015006830000	FRANK UHYREK	WILDCAT	AUSTIN	50262
42015006860000	ZARUBA UNIT 2	SEALY	AUSTIN	50266
42015008120000	ALBERT PESCHEL	NEW ULM	AUSTIN	50402
42015008160000	WALTER HILLBOLDT	WILDCAT	AUSTIN	50408
42015008320000	D C HILLBOLDT UN	SEALY	AUSTIN	50415
42015300940000	GILBERT GLAESER UN	WILDCAT	AUSTIN	50582
42015301030000	HENRY FOERSTER UN	NEW ULM SOUTHWEST	AUSTIN	50587
42015301140000	C A MEWIS	MEWIS	AUSTIN	50602
42015301150000	STASNY ETAL UNIT	MILHEIM	AUSTIN	50603
42015301180000	LUEDECKE-HEIN UN	WILDCAT	AUSTIN	50606
42015301220000	STASNY ETAL UNIT	MILHEIM	AUSTIN	50611
42015301250000	DESSIE LEHMANN	SANTONE	AUSTIN	50614
42015301310000	BEST R	ORANGE HILL SOUTH	AUSTIN	50620
42015301340000	WILBERT GOEBEL	WILDCAT	AUSTIN	50626
42015301350000	RICHARD COLT	WILDCAT	AUSTIN	50627
42015301630000	SAM & H HILLBOLDT	WILDCAT	AUSTIN	50658
42015301830000	MIKSKA-HOLBA G UN	NELSONVILLE	AUSTIN	50671
42015301860000	MIKESKA - BLUM UNIT	BLEIBERVILLE-HMIL	AUSTIN	50675
42015302020000	E P ARNOLD	WILDCAT	AUSTIN	50701
42015302300000	C A MEWIS	WILDCAT	AUSTIN	50733
42015302870000	LOUISE K SCHILLER	NEW ULM	AUSTIN	50783
42015302920000	PALM FRED ETAL UNIT	MILHEIM	AUSTIN	50789
42015302950000	LIEBERMAN	SEALY	AUSTIN	50794

42015303880000	MONROE KOCH GU	NEW ULM	AUSTIN	50803
42015303940000	EBA SCHRADER ETAL	SANTONE	AUSTIN	50812
42015304030000	J J JOHNSTON ETAL	SEALY	AUSTIN	50821
42015304120000	BUTLER RANCH	SANTONE	AUSTIN	50830
42015304150000	CHARLIE BECKER	WILDCAT	AUSTIN	50833
42015304170000	EMMA KOLLATSCHNY	CAT SPRINGS	AUSTIN	50835
42015304250000	KAECHELE	ERVING	AUSTIN	50843
42015304270000	DITTERT RICHARD F	WILDCAT	AUSTIN	50845
42015304390000	PRAUSE GEORGE	WILDCAT	AUSTIN	50858
42015304400000	SCHNEIDER R E	WILDCAT	AUSTIN	50859
42015304480000	FENNER C E /B/	NEW ULM	AUSTIN	50870
42015304520000	KOLLATSCHNY A G ETL	WILDCAT	AUSTIN	50875
42015304590000	WOODLEY	WILDCAT	AUSTIN	50887
42015304640000	GRAF UNIT	SEALY	AUSTIN	50893
42015304670000	KRAUSE EDWIN	NEW ULM	AUSTIN	50896
42015305030000	COOK ROBERT E UNIT	BUCKHORN D3	AUSTIN	50953
42015305150000	HUNDLEY RICHARD Z	WILDCAT	AUSTIN	50963
42015305520000	KOEHN /C/	IVES	AUSTIN	51002
42015305620000	HILLBOLDT CURTIS	ERVING	AUSTIN	51014
42015305730000	PAVELKA J R	WILDCAT	AUSTIN	51030
42015305760000	MAXINE JOHNSTON CART	WILDCAT	AUSTIN	51035
42015305830000	RATHKE E	WILDCAT	AUSTIN	51042
42015306030000	BEST ETAL	ORANGE HILL SE	AUSTIN	51066
42015306210000	TURNBOW	FLOYD J RAY	AUSTIN	51085
42015307190000	SAN FELIPE GU	SEALY	AUSTIN	51199
42015307280000	NEHRKORN UNIT	GIDDINGS	AUSTIN	51213
42015307360000	ORVILLE	WILDCAT	AUSTIN	51230
42015307560000	GOEBEL EVELYN	MILHEIM	AUSTIN	51251
42015307620000	KREN-TEX	WILDCAT	AUSTIN	51257
42015308160000	SUNNY GLEN CHILDRENS	WILDCAT	AUSTIN	51314
42015308190000	SCHNEIDER	REXVILLE	AUSTIN	51317
42015308330000	SCHAER UNIT	ORANGE HILL SOUTH	AUSTIN	51333
42015308350000	BECKENDORFF	REXVILLE	AUSTIN	51335
42015308400000	KAECHELE CHARLES	ORANGE HILL SOUTH	AUSTIN	51344
42015308890000	HILLBOLDT	SEALY	AUSTIN	51401
42001324650000			ANDERSON	52839
42047130293000			BROOKS	52840
42073310840000				52841
42177320560000				52843
42225310310000				52844
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42373309770000				52847
42455304910000				52848
42089008680000	G W HERMES	COLUMBUS WEST	COLORADO	52917
42089009240000	R F POTTER ETAL	WILDCAT	COLORADO	52960
42089301830000	W W FONDREN EST ETL	HAMEL EAST	COLORADO	53074

42089302900000	W H MIEKOW ETAL	MIEKOW	COLORADO	53128
42089303180000	REGINALD TAYLOR	WILDCAT	COLORADO	53140
42089303670000	LEO HOEGEMEYER	BORDEN-HAMILL	COLORADO	53160
42089305390000	HENRY J HAJOVSKY	SUBLIME	COLORADO	53210
42089305900000	MANZANERA L UN	HAMEL SOUTH	COLORADO	53232
42089306220000	D J FERNBACH	WILDCAT	COLORADO	53243
42089306560000	GLASSCOCK C G ETAL	GLASSCOCK	COLORADO	53258
42089309500000	BAYOU PROP	BERNARDO RANCH	COLORADO	53295
42089309580000	HRUZEK	WILDCAT	COLORADO	53296
42089309630000	ERWIN H MEYER	FRELSBURG	COLORADO	53297
42089310170000	JAMES A SCHILLING	EASTER	COLORADO	53319
42089311090000	SCHINDLER LESTER E	WILDCAT	COLORADO	53355
42089311230000	GOODE DAISY	WILDCAT	COLORADO	53362
42089311680000	MOELLER H E ETAL	ROCK ISLAND	COLORADO	53378
42089312120000	EAST HAMEL GAS UN 2	HAMEL EAST	COLORADO	53392
42089313210000	KLEIMANN	GINTHER	COLORADO	53432
42089313520000	SCHIURRING	BUCK SNAG	COLORADO	53442
42089313630000	BARTEK A J GU 2	HAMEL NORTH	COLORADO	53447
42089314210000	VOSKAMP	WILDCAT	COLORADO	53469
42089314380000	GRODHAUS BETTY	RUTLEDGE	COLORADO	53475
42089315710000	HORNDT HARRY W	COLUMBUS SOUTH	COLORADO	53519
42089316110000	DAHSE IRMA UNIT	DUBINA	COLORADO	53534
42089316490000	BOETTCHER /A/	SUBLIME NORTH	COLORADO	53549
42089317410000	RUTTA	FONDREN RANCH	COLORADO	53589
42089319840000	WEBB	CHESTERVILLE N	COLORADO	53700
42089320160000	STRUNK GAS UNIT	SUBLIME NORTH	COLORADO	53718
42089320470000	THOMAS J R	WILDCAT	COLORADO	53734
42089321180000	COOPER E P GU 2	KACEE	COLORADO	53759
42089321380000	COLUMBUS FIELD UNIT	COLUMBUS	COLORADO	53768
42089321430000	KRENEK GAS UNIT	GRACELAND	COLORADO	53773
42089322340000	BROCK JOHN B IV GU	ROCK ISLAND	COLORADO	53799
42089323510000	GLASSCOCK A	GLASSCOCK	COLORADO	53826
42089323760000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53839
42089323860000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53843
42089323900000	FRENSLEY	ZIMMERSCHEIDT	COLORADO	53845
42089323910000	LEYENDECKER	ZIMMERSCHEIDT	COLORADO	53846
42089323920000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53847
42089324050000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53853
42089324070000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53855
42089324110000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53857
42089324140000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53859
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42089324290000	SHERIDAN GAS UNIT	SHERIDAN	COLORADO	53868
42089324530000	TAIT	TAIT	COLORADO	53872
42089325020000	FROELICH B	NEW BIELAU	COLORADO	53894

42149304190000	ROBIN UNIT	GIDDINGS	FAYETTE	55702
42149307680000	WEERAN ETAL UN	GIDDINGS	FAYETTE	55783
42149000320000	RYZA JOHN J	WILDCAT	FAYETTE	56133
42149000360000	BACA V F	WILDCAT	FAYETTE	56135
42149000460000	JANDA GEORGE E	WILDCAT	FAYETTE	56143
42149000690000	MATTINGLY R H	WILDCAT	FAYETTE	56157
42149002060000	L ANDERSON H W ETAL	WILDCAT	FAYETTE	56261
42149300670000	K VERONICA SCHRAMEK	WILDCAT	FAYETTE	56436
42089002830000	WADDELL ZETA	WILDCAT	COLORADO	56499
42089003210000	J W REIMERS	COLUMBUS	COLORADO	56533
42089004140000	GUY F STOVALL	SUBLIME	COLORADO	56609
42089004790000	COSBEY MRS G F	WILDCAT	COLORADO	56660
42089006930000	LEHRER W K ETAL	WILDCAT	COLORADO	56789
42089006960000	LEHRER WM K ETAL	LEHRER	COLORADO	56791
42089007320001	CASO G M	WILDCAT	COLORADO	56825
42089000250000	VOGELSANG FRIEDA	WILDCAT	COLORADO	56906
42089000450000	KELLMAN F G	WILDCAT	COLORADO	56924
42089000950000	NEUENDORFF A	WILDCAT	COLORADO	56965
42089001620000	EVERETT A ESTATE	WILDCAT	COLORADO	57003
42149310520000	RASCHKE EDWIN	KINGS KID	FAYETTE	57091
42149311510000	GUNN L A	GIDDINGS	FAYETTE	57118
42149311820000	HACKEBEIL H O	GIDDINGS	FAYETTE	57127
42149317000000	WILCOX MARY COLLIER	GIDDINGS	FAYETTE	57214
42149317400000	GIGI	GIDDINGS	FAYETTE	57221
42149321560000	BARON	GIDDINGS	FAYETTE	57295
42149322450000	JANECKA D	CISTERN	FAYETTE	57343
42149323000000	SCHRAMM GUSTAVE	WILDCAT	FAYETTE	57367
42149323260000	RUMMEL ELO ETUX	REDMOND	FAYETTE	57384
42149323510000	JACKIE	VANESSA	FAYETTE	57399
42149324270000	ZOCH EUGENE	GIDDINGS	FAYETTE	57449
42149325050000	WARMKE CAROLYN UN	GIDDINGS	FAYETTE	57490
42149325090000	PYBURN-ZOCH UNIT	GIDDINGS	FAYETTE	57493
42149326930000	BERRY	CALLOWAY	FAYETTE	57566
42149327190000	WILLIAMS CREEK	GIDDINGS	FAYETTE	57579
42149327830000	OLDENBURG A	GIDDINGS	FAYETTE	57605
42149327890000	BERGER-AMARADO	GIDDINGS	FAYETTE	57610
42149328260000	HAUSMANN	GIDDINGS	FAYETTE	57628
42149328380000	AMMANSVILLE OL UNIT	GIDDINGS	FAYETTE	57637
42149329120000	KLUMP O L UNIT	GIDDINGS	FAYETTE	57676
42149329360000	PECAN CREEK	GIDDINGS	FAYETTE	57688
42149330010000	ACKER	GIDDINGS	FAYETTE	57726
42149330230000	UHYREK UNIT	GIDDINGS	FAYETTE	57739
42149330300000	SUMP UNIT	GIDDINGS	FAYETTE	57745
42149330340000	KOCIAN OL	GIDDINGS	FAYETTE	57746
42149330380000	ORSAK UNIT	GIDDINGS	FAYETTE	57747
42149330620000	LOESSIN UNIT	GIDDINGS	FAYETTE	57761
42149330770000	KANA UNIT	GIDDINGS	FAYETTE	57771

42149330830000	MECHURA UNIT	GIDDINGS	FAYETTE	57776
42149330960000	SHEPARD JOHN W	GIDDINGS	FAYETTE	57783
42149331030000	JOHNSON	GIDDINGS	FAYETTE	57787
42149331530000	PETRICH-LORENZ	STEPHANIE	FAYETTE	57801
42149331610000	GRACE	GIDDINGS	FAYETTE	57807
42149331620000	SOLIS BARBARA	STEPHANIE	FAYETTE	57808
42149331630000	RODRIGUEZ	S L P	FAYETTE	57809
42149331660000	SOLIS BARBARA	STEPHANIE	FAYETTE	57812
42149331740000	STUERMER HEIRS	JUSTICE	FAYETTE	57814
42149331830000	FANNIE MAE UNIT	GROZIE	FAYETTE	57816
42177000460000	J F ROBINSON	WILDCAT	GONZALES	57852
42177000480000	PRUSWELL A D	WILLIAM HARRY	GONZALES	57853
42177000590000	A J KOLAR	WILDCAT	GONZALES	57863
42177000780000	GEORGE PARR	WILDCAT	GONZALES	57874
42177001170000	VIOLA MORROW	WILDCAT	GONZALES	57904
42177001330000	E WRIGHT	WILDCAT	GONZALES	57915
42177001630000	W SPAHN	WILDCAT	GONZALES	57933
42177002300000	W GROSSMAN UNIT	WILDCAT	GONZALES	57960
42177002440000	ADA HOUSTON COX	WILDCAT	GONZALES	57970
42177002730000	AN ALFRED SPIECKERMAN	WILDCAT	GONZALES	57988
	ACK ANN HAMILTON			
42177002920000	CUSACK	CHEAPSIDE NW	GONZALES	58004
42177002980000	STOELTZE EMIL	WILDCAT	GONZALES	58007
42177003250000	GEORGIA B WELLS	WILDCAT	GONZALES	58020
42177004240000	ROBERT MILLER	WILDCAT	GONZALES	58086
42177004560000	WILLIAM JACOBS	WILDCAT	GONZALES	58109
42177004640000	GEORGIA DUBOSE	DUBOSE	GONZALES	58116
42177004730000	E A SCHRADER	WILDCAT	GONZALES	58123
42177004840000	W P BISHOP JR	WILDCAT	GONZALES	58133
42177004980000	AL MARTN L JHNSN ETAL	WILDCAT	GONZALES	58140
42177005080000	DONALD HOLT	WILDCAT	GONZALES	58148
42177005240000	FRANK ULLMAN	CHEAPSIDE	GONZALES	58160
42177005630000	ELL BERTA MORE CALDWELL	WILDCAT	GONZALES	58188
42177005660000	JANIE L SAMPLE	WILDCAT	GONZALES	58189
42177006000000	MONROE A SCHAUER	WILDCAT	GONZALES	58208
42177006160000	ARMOUR L DAVIS	WILDCAT	GONZALES	58218
42177300980000	G U DIXN-MUNS-TEXFL G U	WILDCAT	GONZALES	58256
42177301370000	D C MC MANUS	WILDCAT	GONZALES	58267
42177303890000	OSBORN	WILDCAT	GONZALES	58326
42177304240000	J M DUBOSE	WILDCAT	GONZALES	58338
42177304490000	E D SHELTON	PILGRIM	GONZALES	58350
42177305890000	KIFER MRS L A	COST	GONZALES	58391
42177307440000	KOKERNOT FD	DILWORTH SOUTH	GONZALES	58433
42177308120000	HINTON C L	WILDCAT	GONZALES	58465
42177309650000	MANFORD	COST	GONZALES	58512
42177309790000	CANTLY	COST	GONZALES	58520
42177310670000	CANION UNIT	SMILEY	GONZALES	58548

42177316060000	AL UNAGEL MILDRED ETAL U	PEACH CREEK	GONZALES	58696
42177318110000	ESCHENBURG	PILGRIM	GONZALES	58811
42177318710000	BURNETT	PILGRIM	GONZALES	58841
42177319070000	STEEN-PARAMOUNT	AUSTIN PIERCE	GONZALES	58861
42177319180000	DOPSLAUF F W	PEACH CREEK	GONZALES	58868
42177319920000	TEXAS TEA	PILGRIM	GONZALES	58916
42177320510000	BAKER UNIT	DUBOSE	GONZALES	58955
42285000060000	LOUIS PAVLAS	WILDCAT	LAVACA	59048
42285000070000	E G OLSOVSKY	WILDCAT	LAVACA	59049
42285000100000	N EMILLIE SEBASTIAN	WILDCAT	LAVACA	59051
42285000130000	PAUL STOCK	WILDCAT	LAVACA	59052
42285000140000	EDGAR LAAS	WILDCAT	LAVACA	59053
42285000280000	F JULIUS WOLFSDORFF	WILDCAT	LAVACA	59060
42285000290000	L C WOLFSDORFF	WILDCAT	LAVACA	59061
42285000310000	BAUM G K	SUBLIME	LAVACA	59063
42285000890000	E DELAUNE	VIENNA	LAVACA	59112
42285001690000	CARLA ROBERTSON	SPEAKS SOUTHEAST	LAVACA	59161
42285001900000	VASEK BOHUMIL	MARTISEK	LAVACA	59175
42285001920000	WOJTEK UNIT	MARTISEK	LAVACA	59177
42285002380000	SPANIHEL UNIT	WORD	LAVACA	59212
42285003200000	AL MAGGIE KARNEY ETAL	SPEAKS SOUTHWEST	LAVACA	59260
42285003480000	T C CHANDLER	YOAKUM	LAVACA	59281
42285003490000	W A KUHN UNIT	YOAKUM	LAVACA	59282
42285003500000	REESE WM UNIT	YOAKUM	LAVACA	59283
42285003520000	TURNER UNIT	YOAKUM	LAVACA	59284
42285003550000	R VICK ETAL	WILDCAT	LAVACA	59285
42285003580000	ALLEN CARTER	WILDCAT	LAVACA	59286
42285003590000	FRED SCHULTZ	WILDCAT	LAVACA	59287
42285003600000	MARY L QUOTA	WILDCAT	LAVACA	59288
42285003650000	JIM PATEK	WILDCAT	LAVACA	59289
42285003790000	FRANK J ORSAK	WORD	LAVACA	59295
42285003820000	SYLVIA W KAHANEK	WORD	LAVACA	59297
42285004570000	ARTHUR E EVANS	WILDCAT	LAVACA	59343
42285004920000	J H DIAL	HOPE SOUTH	LAVACA	59360
42285005020000	ELLA FITZHENRY	HOPE	LAVACA	59369
42285005470000	TURNER UNIT	YOAKUM	LAVACA	59400
42285005720000	WESLEY WEST	PROVIDENT CITY	LAVACA	59416
42285006120000	W A CARNES	YOAKUM	LAVACA	59443
42285300030000	ALVES UNIT	YOAKUM	LAVACA	59460
42285300420000	ALVIN MIKULENKA	WILDCAT	LAVACA	59490
42285300520000	D UNDERWOOD	WILDCAT	LAVACA	59496
42285300890000	A D VOSKAMP	WILDCAT	LAVACA	59525
42285300960000	U 1 ANNIE BROWN ET GU 1	WORD NORTH	LAVACA	59530
42285301910000	J E TIMM	WILDCAT	LAVACA	59562
42285302000000	HONEY CREEK	WILDCAT	LAVACA	59565
42285302050000	PAUL WOYTER	WILDCAT	LAVACA	59568
42285302480000	JULIUS BUJNOCH	WILDCAT	LAVACA	59578

42285302920000	UN ANNIE BROWN ETAL UN	WORD NORTH	LAVACA	59593
42285304070000	UX JAMES A BAROS ETUX	WILDCAT	LAVACA	59623
42285304860000	K LANDRY G UN	YOAKUM SOUTHEAST	LAVACA	59652
42285305170000	LANDRY B	YOAKUM SOUTHEAST	LAVACA	59662
42285305230000	SADA BARNES	HALLETTSVILLE E	LAVACA	59666
42285306690000	V J SMOLIK	WILDCAT	LAVACA	59707
42285306760000	B ANDERSON GU	HALLETTSVILLE S	LAVACA	59710
42285307080000	LOUIS MATULA	HALLETTSVILLE S	LAVACA	59720
42285307160000	T A ETZLER GAS UNIT	HALLETTSVILLE S	LAVACA	59724
42285307220000	NIT A G HENKES GAS UNIT	HALLETTSVILLE S	LAVACA	59726
42285307240000	1 MONT GAS UNIT NO 1	MONT	LAVACA	59727
42285311590000	WILLIAM A EILERS	HALLETTSVILLE S	LAVACA	59731
42285311900000	ET GENE F COUCH-VLB ET	HALLETTSVILLE S	LAVACA	59742
42285312170000	RELM J B	WILDCAT	LAVACA	59750
42285312220000	DZIEWAS	HALLETTSVILLE S	LAVACA	59751
42285312520000	1 KOERTH GAS UNIT 1	KOERTH	LAVACA	59760
42481301050000	W C LEVERIDGE ETAL	WILDCAT	WHARTON	59880
42285312770000	TAL E B CARTER EST ETAL	SWEET HOME	LAVACA	59970
42285313750000	A J GUIDRY UNIT	SWEET HOME	LAVACA	59996
42285313860000	BERTHA ANDERSON	WILDCAT	LAVACA	60003
42285313940000	TUSA MRS THEO S	TUSA	LAVACA	60005
42285314010000	T GRAHMANN GAS UNIT	HALLETTSVILLE S	LAVACA	60007
42285314130000	TE MELNAR FRED ESTATE	WORD	LAVACA	60010
42285314260000	NAJVAR PAUL	WILDCAT	LAVACA	60012
42285314470000	KRISTEK GAS UNIT	WORD NORTH	LAVACA	60019
42285314590000	NELSON CHARLENE	HALLETTSVILLE S	LAVACA	60025
42285314950000	HANNA E L	KOERTH	LAVACA	60035
42285314960000	ASCHBACHER C F	VIENNA	LAVACA	60036
42285315000000	KUPKA A J ETUX	SWEET HOME	LAVACA	60038
42285315090000	LANDRY J H	WILDCAT	LAVACA	60043
42285315110000	E CLARKE C B ESTATE	SPEAKS SOUTHWEST	LAVACA	60045
42285316180000	CARTER ESTATES	SWEET HOME	LAVACA	60082
42285316870000	LOWRANCE RANCH	EVANS	LAVACA	60100
42285316890000	SCHINDLER VICTOR	MONT	LAVACA	60101
42285317360000	1 GRANBERRY W M OU 1	SWEET HOME	LAVACA	60122
42285317400000	S GAHEIERMANN-HERMESS GA	KOERTH	LAVACA	60123
42285318220000	VOGELSANG	WILDCAT	LAVACA	60153
42285318480000	ALLEN WILLIAM	PROVIDENT CITY	LAVACA	60166
42285319100000	WYNNE GAS UNIT	WORD NORTH	LAVACA	60196
42285319140000	ETL KOETHER SELMA J ETL	WILDCAT	LAVACA	60198
42285319260000	HERMES MAURICE P	KOERTH	LAVACA	60204
42285319280000	JANAK F W	WORD NORTH	LAVACA	60205
42285319480000	1 RANDOW GAS UNIT 1	WORD NORTH	LAVACA	60217
42285320140000	RIE HUEHLEFELD MARJORIE	SWEET HOME	LAVACA	60248
42285320290000	E GARRETT HELEN MAE	WILDCAT	LAVACA	60256
42285320660000	MEADOR	WILDCAT	LAVACA	60272

42285320900000	HOBIZAL UNIT	HOPE	LAVACA	60286
42285320950000	HAVEL UNIT	SWEET HOME	LAVACA	60290
42285321030000	PRITCHARD	WILDCAT	LAVACA	60293
42285321120000	KUBENA GAS UNIT	WORD NORTH	LAVACA	60297
42285321320000	FREUDE UNIT	YOAKUM	LAVACA	60310
42285321700000	WYNNE GAS UNIT	WORD NORTH	LAVACA	60327
42285322050000	GARRETT	DRY HOLLOW NORTH	LAVACA	60343
42285322430000	GA HATHAWAY EDWARDS GA	WORD NORTH	LAVACA	60349
42285322650000	UNI KRUPALA E J GAS UNI	WORD NORTH	LAVACA	60359
42285322710000	PARR GAS UNIT	HALLETTSVILLE S	LAVACA	60362
42285322820000	SESTAK	WILDCAT	LAVACA	60365
42285323210000	GERLICH GAS UNIT	WORD NORTH	LAVACA	60375
42285324270000	CHANDLER UNIT	YOAKUM	LAVACA	60410
42285324450000	CHEVRON COBY	WILDCAT	LAVACA	60412
42285325030000	GERLICH GAS UNIT	WORD NORTH	LAVACA	60423
42285325160000	SOBOTIK F GU 1	WORD NORTH	LAVACA	60426
42285325490000	T LAWRENCE GAS UNIT	HALLETTSVILLE S	LAVACA	60439
42285327260000	1 KOERTH GAS UNIT 1	WILDCAT	LAVACA	60464
42285330780000	UNINEWBERN ETAL GAS UNI	HOPE	LAVACA	60484
42285331080000	AS UHENDERSON ETAL GAS U	THE RAPTURE	LAVACA	60493
42285331090000	S UNRENGER HARVEY GAS UN	RENGER	LAVACA	60494
42285331350000	MUELLER GAS UNIT	HALLETTSVILLE E	LAVACA	60501
42285331400000	HARBUS TRUST	HALLETTSVILLE S	LAVACA	60503
42285331440000	SAMPLES	YOAKUM	LAVACA	60505
42285331490000	S) GPOHL H A (EDWARDS) G	WORD NORTH	LAVACA	60506
42285331500000	SMOLIK	MONT	LAVACA	60507
42285332170000	BELICEK	CAMPBELL CREEK	LAVACA	60520
42285332290000	GERDES A UNIT	WORD	LAVACA	60525
42285332300000	JANAK	HALLETTSVILLE S	LAVACA	60526
42285332560000	TURNER GAS UNIT	YOAKUM	LAVACA	60535
42285332900000	NIT HERMES C L GAS UNIT	STINGRAY	LAVACA	60549
42285333070000	FOSTERS	TIGER BEND	LAVACA	60554
42285333120000	KLIMITCHECK GU 1	RENGER	LAVACA	60555
42285333340000	WOLF-COWLING	HALLETTSVILLE E	LAVACA	60566
42285333350000	D GAKUENSTLER LEONARD GA	STINGRAY	LAVACA	60567
42285333630000	BUTSCHEK \`A\`	WORD	LAVACA	60577
42285333730000	DAVIDSON	GIVN TAKE	LAVACA	60583
42285334040000	MCEWANS	WARD NORTH	LAVACA	60593
42285334100000	GERDES UNIT	JANSKY	LAVACA	60595
42285334110000	ALLEN	HALLETTSVILLE	LAVACA	60596
42285334680000	GERDES UNIT	JANSKY	LAVACA	60605
42285334940000	FRIESENHAHN	WILDCAT	LAVACA	60611
42285335170000	STARY	HOPE	LAVACA	60619

42285335210000	FRANK GAS UNIT	DRY HOLLOW	LAVACA	60620
42285335550000	WELHAUSEN	WILDCAT	LAVACA	60625
42149324230000	KRAATZ ERWIN	GIDDINGS	FAYETTE	66024
42149324560000	IT CRUSE-LEHMANN UNIT	GIDDINGS	FAYETTE	66025
42149324810000	/A KRAATZ-SORRELLS /A/	GIDDINGS	FAYETTE	66026
42149331860000	ROCKY	CALLOWAY	FAYETTE	66027
42149332080000	ROYAL ET AL	GIDDINGS	FAYETTE	66028
42149332100000	LEHMANN ET AL	BIG JOE	FAYETTE	66029
42149332130000	MCKINNEY UNIT	GIDDINGS	FAYETTE	66030
42149332140000	TALLEY	GIDDINGS	FAYETTE	66031
42177321140000	KELLEY	PEACH CREEK	GONZALES	66038
42285328640000	ZALMAN	SPEAKS SOUTHWEST	LAVACA	66040
42287311340000	DIRK	GIDDINGS	LEE	66042
42287325320000	WASHINGTON	KRUEMCKE	LEE	66050
42287307940000	SIGMUND O H JR ETUX	GIDDINGS	LEE	66291
42287319030000	HERTER /A/	WILDCAT	LEE	66508
42287320280000	HANNES CALVIN	SERBIN	LEE	66580
42287320530000	HOLMES	SERBIN	LEE	66595
42287321990000	THERIOT	WILDCAT	LEE	66661
42287322920000	LEHMANN IRA J	GIDDINGS	LEE	66721
42287323150000	SACKS SYLVIA	GIDDINGS	LEE	66740
42287323250000	JIM BUDDY	HOOKER CREEK	LEE	66746
42287323840000	STRINGER	GIDDINGS	LEE	66781
42287000280000	BIGGERS J A	WILDCAT	LEE	66876
42287000320000	SACKS S	WILDCAT	LEE	66878
42021007870000	ETTA HESS	WILDCAT	BASTROP	67109
42021007950000	JOHNNY FIEBRICH	WILDCAT	BASTROP	67112
42021008200000	FRANK RUNDUS	WILDCAT	BASTROP	67124
42021300810000	ROSANKY	WILDCAT	BASTROP	67171
42021305730000	POLANSKY	WILDCAT	BASTROP	67253
42021310550000	PETZOLD	SERBIN	BASTROP	67338
42021311090000	MATTINGLY	SERBIN	BASTROP	67367
42321026860000	BAER RANCH A	BAER RANCH	MATAGORD	72376
42321320170000	MAD ISLAND UNIT 1	MAD ISLAND	MATAGORD	72782
42481337040000	DOROTIK \`A\`	NEW TAITON	WHARTON	73064
42481342240000	DUNCAN	DYNAMIC	WHARTON	73192
42481342510000	ANDERSON	BONUS SOUTHWEST	WHARTON	73215
42481343180000	ROCKING M LAND & CAT	BONUS SOUTHWEST	WHARTON	73269
42481343680000	DUNCAN	NEW TAITON	WHARTON	73297
42481345380000	PEACH CREEK GAS UNIT	DYNAMIC	WHARTON	73400
42089326130000	POWERS	GINTHER	COLORADO	73674
42321321020000	MILLER A-14	RAMONA D3	MATAGORD	73763
42021001380000	STOPPELBERG JOHN	PAIGE	BASTROP	74038
42021001390000	F G ROESENER	PAIGE	BASTROP	74039
42055000770000	HOLLOWAY & MANNELLA	WILDCAT	CALDWELL	74094
42055000790000	W P HOLLOWAY ETAL	WILDCAT	CALDWELL	74095

Appendix D

Detailed descriptions of the cross sections.

Section A-A'

AA' (Fig.23), a depositional dip line, highlights the progradational nature of the Upper Wilcox clastic wedge over the Yoakum Canyon region. Although this cross section does not run through the axis of the canyon, well positioning was ideal along A-A' to highlight the regressive shoreline pattern through time. Cross section AA' runs 77km from the top of Fayette County to the base of Lavaca County and is 190m thick at well 1A thickening to 280m in well 6A (Figure 23).

The Middle Wilcox clastic wedge in AA' displays features that align with observations from previous workers: that it is a shale dominated wedge between two sandier units (Xue & Galloway, 1995). The lateral edge of the Yoakum Canyon can be observed in the Middle Wilcox in well 1A. The canyon also appears as previously described, as a mud filled unit that in places reaches thousands of feet thick but with occasional sandstone units (Dingus, 1990; Dingus, 1987; McDonnell et al., 2008). The mud-dominated canyon fill seen in 1A shows over 300m of fine material but does not extend to the adjacent landward well of AA'.

The Yoakum Shale, highlighted by the red maximum flooding surface at the base of sequence 1, is a high gamma-ray pick in all of the wells in AA' providing the base of the Upper Wilcox Clastic Wedge. Sequence 1 begins above the Yoakum Shale with coarsening up delta/ shoreface features in wells 1A, 2A, 4A, 5A and prodelta muddy/fine facies in 3A and dominating in 6A. These facies reflect the embayed nature of the regressive shoreline in Sequence one over the Yoakum Canyon region. Sequence 1 is relatively thin in comparison to the other sequences in AA', with maximum thickness values only reaching 20m in well1A.

Sequence 2 is much thicker and shows sandier facies than Sequence 1 below. Gamma-ray signatures in the landward section, A1, and A2, display sharp based and blocky thick sandstones indicative of fluvial bodies. Due to the extreme thickness, 70m, of the sandstone in well A2 and its updip location, there is a possibility that this sandstone body actually represents an incised valley (Gibling, 2006; Plint & Wadsworth, 2003). With either interpretation, the sandstones in A1 and A2 are divided in the middle by a small section of slightly finer material. progradation system (delta),deposits (estuary). Finning upward trends interpreted to be fluvial signatures were not present in Sequence 1, and have prograded ≥20km into the basin after the earlier transgression. Well A3 through well A5 show a coarsening up delta/shoreface facies grading basinward into the muddier prodelta facies. The delta/shoreface facies sandstones are thickest in A3 where they achieve 18m of upward coarsening material. The muddier facies continues to dominate downdip in wells A4 and A5, in well A6, 80% of the 45m of the preserved sediment consists of the fine prodelta facies with only two coarsening up sandier units.

The most noticeable difference between Sequence 2 and 3 is the basinward progradation of the fluvial facies in Sequence 3. Distinct sharp based blocky signatures of the fluvial sandstone units reach well A5 during Sequence 3. The overall 35km progradation of the fluvial system through the basin between the sequences is significant. Once again, the extreme thickness of the sandstones in the updip wells, A1-3, raises a question of these being incised valley fill units. The sandstones in A2 show an initial coarsening up and then after 20m, a change to a fining up pattern, pointing to the preservation of both the regressive deposits as well as the overlying transgressive ones. Wells A1 and A3 are more ambiguous in their coarsening or fining up patterns, leaving the interpretation of having a transgressive or regressive label assigned. Sandstone in well A4 and the 3 sandstone units in A5 show some upward fining trends. At least the uppermost of the upward fining trends suggests transgressive backstepping of Sequence 3. Well A5 shows an inter-fingering of sandstones and fines which is interpreted as interplay between fluvial and delta plain facies. Downdip in well A6, there are 4 upward coarsening sandy units interpreted as delta/ shoreface facies. The delta/ shoreface depositional system made a 35 km basinward shift within the embayment similar to the fluvial facies between Sequences 2 and 3.

Sequence 4 has the first significant alluvial and flood plain deposits in cross section AA'. Wells 1A and 2A have 15-25m of flood plain deposits underlying 8-12m of alluvial plain deposits. The presence of the alluvial and flood plain log facies in Sequence 4 and lack thereof in Sequence 3 again highlights the overall progradation of the system through time. Sandier fluvial channel deposits begin to appear in A3, shown by a set of sharp based sandstones reaching individual thicknesses of 5m. Well A4 is almost entirely composed of thick fluvial sandstone units, up to 15m, underlined by more floodplain mudstone. The sandstones in A4 may show the clearest preservation of the transgressive period of Sequence 4 with the 7m thick upward fining deposits. In well A5 sequence 4 the sharp-based blocky sands form two distinct stacked units; they are 25m and 15m thick respectively. The fluvial units have prograded 15km between Sequence 3 and the overlying Sequence 4 continuing the basinward shift in facies observed in sequences 1-3. Could these thick blockt sands be incised valleys?

Capping the Upper Wilcox clastic wedge in the Houston Embayment is the mud dominated Sequence 5. The top of the Upper Wilcox is defined as the Reklaw Shale (Hargis, 1996; Sams, 1990) recognized in the well by high gamma ray spike above Wilcox sandstones, highlighted with a red MFS line in Figure 23. Much of Sequence 5 prodelta mudstones overlie fluvial units. This relationship is schematically explained by Figure (3.1.A and 3.1.B) where transgressive mudstones come in direct contact with fluvial channels due to a rapid rate of transgression or a shallow alluvial plain gradient. Some of the sandstones, most easily seen in wells 1A and 2A, show sharp bases fining up into tens to a hundred meters (Figure 23) of fine material which are interpreted to be estuary facies. This pattern is seen in all of the wells of AA' in Sequence 5 with varying amounts of coarser sandstone material at the base. The shoreline for Sequence 5 has transgressed beyond the region covered in this dataset, or greater than 77km, the dip distance covered by this cross section.

The trend through cross section AA', sections 1-4, is one of overall basinward shift in depositional facies. Fluvial channel log facies and delta/shoreface log facies prograde at least 77km through the 5Ma (Crabaugh & Elsik, 2014) of the Upper Wilcox clastic wedge. AA' shows the strongest progradation into the Houston Embayment, cross sections to the northeast BB' and then CC' display a transition from a progradational shoreline, to an aggradational one.

Section B-B'

This cross section was selected to show the median between the progradational shoreline in the southwest (AA'), and the aggradational shoreline in the northeast (CC'). BB' extends for 110km running landward to basinward from the bottom of Lee county, well 1B where it is 170m thick, to the top of Fort Bend county, well 6B where it is 335m thick (Figure 23).

The Yoakum Shale initiates the Wilcox clastic wedge, and runs below Sequence 1, highlighted with a solid red MFS line (Figure 24). Sequence 1 in BB' shows considerably more alluvial plain and other non-marine depositional systems than it did in

AA'. BB' is located in the northeast of the embayment were more distinct delta and marine deposits created specific log signatures in AA'. Sequence 1 thickens considerably as it enters the basin, changing from 8m in well 1B to 70m in well 6B. Wells 1B-4B are dominated by muddy facies interspersed with channels bodies that do not dominate and are interpreted (see Figure 2.1.4 for model) to be alluvial plain depositional facies. There are very thin estuary units present in the tops of wells 3B-5B that cap the underlying units of Sequence 4. Well 5B shows two upward coarsening deltaic patterns, 3m thick and one 9m thick in a finer matrix interpreted to be delta plain deposits that lie lateral to the delta front deposits. Further basinward, well 6B is dominated by a higher reading gamma-ray pattern commonly segregated by thin upward coarsening sandstones. These units which are 62m thick are interpreted to consist of prodelta/ shelf log patterns.

Sequence 2 on section B-B' (Figure 24), beginning at 15m thick in well 1B expands to 100m in well 6B, shows similar downdip-coarsening displayed in Sequence 1. Well 1B is made up of one coarse based sand body that is 12m thick, with a 2m capping unit of fining upward estuary deposits. The sharp based upward fining fluvial sandstone in wells 1B-4B all preserve the updip transgressive portion of Sequence 2 in BB'. Well 2B has a 6m fluvial sandstone that is contained between two alluvial plain deposits. Another sharp based fluvial interpreted sandstone is present in well 3B, thickening to 12m from 2B. The adjacent well, 4B shows more diverse preserved depositional environments beginning with 30m of alluvial plain at the base, to 8m of fluvial in the middle, and 6m of sharp based upward fining interpreted to be estuary deposits preceding the flooding surface that caps the sequence. Between wells 4B and 5B the alluvial plain, fluvial, and estuary deposits interfinger with the delta plain deposits that dominate well 5B. There is one distinct delta in the middle of Sequence 2 in 5B which is composed of 10m of upward coarsening sandstone.

Thick upward coarsening deltas are present in the upper half of Sequence 2 in well 6B. The 30m and 10m thick sandstones in the transgressive half of the where sandstone preservation is typically reserved for more landward regions deserves questioning. One explanation is that the delta system formed to the southeast for most of the section (as is seen in Figure 3.2.2.2), and only in the latter half did the trunk channel avulse to deposit the full load more to the northeast where BB' documents it. To have this supply scenario be a plausible explanation, the transgression would have to have not traveled very far landward between Sequences 2 and 3 to allow such sediment to be deposited so far basinward in the transgressive half of a sequence (see figure 2.2). This stunted bayline (transgressive shoreline) is exactly what is observed over Colorado County updip of well 6B in Figure 3.2.2.4, confirming this explanation.

Sequence 3 preserves a thick, 30m, fluvial unit of sandstone in well 1B. The gamma-ray pattern has a sharp base and fines upwards, likely indicating that these sandstones were deposited in the landward region and preserved during the transgressive stage of Sequence 3. The fluvial sandstone maintain their thickness and continue into well 2B as were deposited over a 15m thick alluvial plain deposits. Wells 3B and 4B are host to a unique set of 5-10m coarsening up log patterns that are updip of the coastline. The coarsening up log signatures are interpreted to have been deposited in swamp/lake depositional environments (Figure 2.1.4). The Sequence 3 coastal plain region of the Upper Wilcox clastic wedge lies between the Colorado and Brazos deltas (Figure 1.2) of the underlying Lower Wilcox platform (Figure 1.2.2). The inter-deltaic space allows for the overriding weight of the Upper Wilcox deposits to compact the muddy underlying substrate and generate local topographic lows for the interpreted lakes to form in. The lakes sit on floodplain muds below and are capped by alluvial and delta plain environments above. Well 4B has a large 15m fluvial channel at the base of Sequence 3.

The various facies present in well 4B grade basinward into delta plain deposits that make up the majority of Sequence 3 in well 5B. There are two thin, 8m, upward coarsening sandstone units in the overall delta plain matrix of 5B. All of the 100m of preserved sediment in well 6B are interpreted as stacked delta/shoreface deposits. Individual units do not reach thicknesses seen in Sequence 2; instead the section is composed of many <12m upward coarsening sandstones that are interspersed with finer mud strata.

The sequence 4 in BB' shows 10km of progradation of the fluvial facies present in well 5B, in contrast to the more aggradational sequences below where the fluvial patterns are restricted to wells 1B-4B. The landward extent of Sequence 4 hosts thick fluvial sandstones in wells 1B and 2B. Sandstones in well 1B are composed of three stacked blocky units averaging 12m, whereas the sandstone body in 2B is a single 25m unit. The thick sandstone in 2B shows both slight upward coarsening and then slight upward fining which could be indicative of preservation of fluvial deposits in both the regressive and transgressive phases of Sequence 4. Well 3B shows mainly fine sediments with some 0.5-2m thick sandstone beds, this unit is interpreted to be floodplain/ overbank deposits. One of the sandstones from well 3B correlate to a sandstone unit in well 4B that is 5m thick. Well 4B is largely composed of a series of interchanging blocky sandstone units, 3-8m thick, and ~5m floodplain/ overbank mudstones. Two large blocky sandstone bodies, 20m each, make up the bulk of Sequence 4 in well 5B. The two sandstone units are interpreted as channel bodies that over lay a 10m muddy delta plain deposit. The fluvial depositional environment present in well 5B documents the 10km progradation of previously aggradational fluvial deposits in the Upper Wilcox along B-B'. The fluvial and delta plain facies from 5B grade into a delta/shoreface dominated regime that continues through the end of B-B' in well 6B. The delta/shoreface deposits overlying on top of fluvial sandstone can occur when there is a rapid transgression or where the shelf gradient is relatively low (Figure 3.1.B) Sequence 4 in well 6B is dominated, 70%, by the delta/shoreface facies with one thin unit of prodelta muds interjected about two thirds of the way up the sequence.

Sequence 5 in B-B' is dominated by the muddy prodelta facies similar to the one described in section A-A'. All of the wells with the exception of 3B have sharp based sandstone that grade into finer material and are interpreted as estuarine deposits. Above the estuary pattern, all of the wells display an upward fining log pattern that continues into tens of meters of muds that make up the Reklaw Fm., condensed section, capping the Upper Wilcox clastic wedge.

The cross section B-B' shows the aggradational to slightly progradational nature of the depositional facies in the middle of the Houston Embayment during Upper Wilcox times. The progradation of 10km between sequences 2 and 3 is far less than that of 70 km observed in A-A' and is considerably more than the aggradational to retrogradational facies shift of section C-C'. The lake deposits interpreted in B-B' is a unique set of well signatures that is not observed anywhere else in the Houston Embayment's Upper Wilcox clastic wedge.

Section C-C'

Cross section C-C' runs 95km from Brazos County in the northwest where it is 175m thick to Harris County in the southeast where it is 310m thick. This dip-oriented cross section was chosen for its ability to highlight the aggradational to retrogradational nature of the depositional systems in the northeast of the Houston Embayment during the deposition of the Upper Wilcox clastic wedge. This cross section is the furthest east from the Yoakum Canyon region, and therefore is least affected by the embayed shorelines of the lower sequences over Lavaca and Colorado counties. The shoreline in C-C' quickly prograded across the stable substrate provided by the underlying Brazos Delta (Figure 1.2) and then aggraded and stepped landward through time.

Sequence 1 begins above the Yoakum Shale MFS highlighted by the red line below the Upper Wilcox clastic wedge (Figure 25). The sequence starts with a 20m section of alluvial plain deposits in well 1C with a thin, 5m thick, section of estuarine deposit on top. Well 2C shows the first sharp based blocky deposits of a fluvial system that entered the region from the north which may correspond to Miller's (1989) unnamed axis (Figures 9 and 28.A) (Miller, 1989). The 15 m thick blocky sandstones have been interpreted as fluvial deposits and, due to their updip location, were probably deposited and preserved in the transgressive half of Sequence 1. Overbank/ floodplain muds and more alluvial plain deposits lie under the fluvial facies in well 2C. The fluvial deposits thicken basinward to 30m, accounting for almost all of Sequence 1 in well 3C. This sharp based sandstone package coarsens up for the first 15m and then fines up slightly for the next 15m. . Well 4C is also almost entirely composed of another 30m of the sharp based blocky pattern seen in wells 2C and 3C. There is 5m of a finer grained unit below that is interpreted to have been deposited in a delta plain environment. The region between wells 4C and 5C preserve the last of the previously dominant fluvial facies, and continues with delta/shoreface environments that dominate basinward for the rest of Sequence 1. Wells 5C and 6C consist largely of <10m coarsening upward bodies of sandstone interpreted to be deltas. There is a small tongue of prodelta mudstone between the deltas of well 6C.

The second sequence in C-C' also begins with the alluvial plain facies for 10m before transitioning to a blocky sandstone unit for 10m, and then reverting back to the alluvial plain log pattern There are 5m of both overbank muds and estuary deposits at the top of Sequence 2 in well 1C. These log facies extend basinward, with the bottom alluvial plain deposit pinching out before reaching well 6C. The other log facies pull through well 6C, interchanging at narrow 5m intervals from floodplain/ overbank mudstones to small channels and back again. The same interchanging pattern of small channels and floodplain/ overbank facies continues into the upper half of Sequence 2 in well 3C. The lower 35m of well 3C is composed of one 10m upward coarsening delta/ shoreface sandstone and 20m of surrounding muddier delta plain facies. The deltaplain and delta/shoreface log facies expand basinward to be the dominant environment in well 4C. The absence of any fluvial deposits at this well location indicates a landward shift in log facies of 15km between Sequence 1 and Sequence 2. With the exception of the region-wide Reklaw transgression in Sequence 5, this retrogradation is the only example of landward stepping facies in the Upper Wilcox in the Houston Embayment. Sequence 2 thickens downdip to 80m in well 4C. The dominating log facies are delta/shoreaface and the muddier delta plain log facies. The upper half of well 4C displays a generally upward fining pattern, indicative of deposition in the transgressive period of Sequence 2. The sequence thickens considerably into well 5C, reaching a total thickness of 105m. Over half of this section consists of upward coarsening log patterns interpreted to be delta/ shoreface deposits. The rest of the section, 40%, preserves a muddier facies interpreted to be deposited in a deltaplain environment lateral to the sandy delta/shoreface environments. The most basinward log facies preserved in well 6C show three upward coarsening delta/ shoreface environments with respective thicknesses of 15, 18, and 10m. The sandstone deposits are encased in finer units that are interpreted to have been deposited in a prodelta environment.

Muddy alluvial plain deposits dominate Sequence 3 in well 1C with 40m of preserved sediment. This muddy log facies transitions downdip to a mix of interchanging blocky fluvial log facies and muddy floodplain/ overbank deposits. The lower fluvial unit is composed of a repeating series of 1-5m thick sandstones combining to make a 15m sandstone unit, the second channel body near the top is one ten meter sandstone unit that fines up and was probably preserved in the transgressive phase of deposition. Well 3C also has two fluvial bodies, each one preserving 15m of sediment. The fluvial sandstone bodies are punctuated with 3m delta plain and floodplain/ overbank deposits. Like in Sequence 2, well 3C preserves the most basinward fluvial sediment present in Sequence 3. Downdip in well 4C, the facies transition entirely to delta/shoreface and delta plain deposits. The delta/ shoreface sandstones are all relatively thin, <4m, and have thin delta plain deposits interspersed in the muddier sections of the well. There is one upward coarsening 5m delta/ shoreface sandstone present in well 5C. The rest of the well encases that sand body with muddy facies interpreted be delta plain and prodelta mud facies. The combination of muddy units in well 5C account for 90% of Sequence 3 in the well. Muddy units interspersed with occasional delta sandstone dominate the rest of Sequence 3. Well 6C contains two 10m upward coarsening sandstones that are interpreted to have been deposited in delta/ shoreface environments.

The dominant alluvial plain facies in Sequence 4 in well 1C is punctuated by a single, 5m, blocky fluvial sandstone and is capped by 10m of estuary deposits. Basinward, the next two wells, 2C and 3C are dominated by sharp-based coarse fluvial deposits measuring 40m and 50m respectively. They are underlain by muddy alluvial plain and floodplain/ overbank muds. These fluvial facies grade into delta plain deposits punctuated with a series of <5m deposits of delta/ shoreface, fluvial, and floodplain/ overbank in well 4C. A sharp transition to almost complete prodelta mud facies occurs between wells 4C and 5C. There is one 5m delta/shoreface sandstone in 5C preserved near the top of the sequence. The prodelta muds continue to be pervasive and thicken downdip until well 6C shows a series of upward coarsening sandstone bodies interpreted to represent delta/shoreface environments. The largest unit of sandstone, 25m, is preserved near the base of Sequence 4 and was preserved during the regressive stage of the sequence. Above the large unit there are three smaller sandstone bodies ranging between 5-10m thick. At 120m, Sequence 4 in well 6C accounts for the largest preserved deposit in cross section C-C'.

Sequence 5 in cross section C-C' is dominated by the muddy prodelta facies that was deposited during the massive regional Reklaw transgression (Hargis, 1996; Sams, 1990). The mudstones dominate in wells 1C, 5C and 6C. In wells 2C, 3C and 4C there are preserved sharp based upward fining sandstone bodies, around 20m each, interpreted to have been deposited in an estuary environment.

Cross section C-C' displays the strong aggradational and slightly retrogradational nature of the of the Upper Wilcox clastic wedge facies in the northwest of the Houston Embayment. These shifts are in contrast to the strongly progradational nature of A-A', and to a lesser extent, B-B'. The rapid progradation across the preexisting stable substrate provided by the Guadalupe Delta (Figure 6) of Sequence 1 delivered sediment to the edge of the preexistent shelf. The delivered sediments of the Upper Wilcox were focused in the southwest of the embayment, and what sediment did make it to the shelf edge in C-C' were deposited into soft accommodating muds that strongly growth faulted, stunting further progradation.

Strike Cross Sections

The strike cross sections were constructed in the same way that the dip cross sections were (delineated in the methods section of this thesis), to highlight changes of and interactions between the depositional environments in the Houston Embayment during the Upper Wilcox's deposition. Log signature patterns were interpreted by way of Figure 13. Channel bodies were added to the facies-mapped strike cross sections. Each channel was sized based on the height of the sand body observed in each well and has an aspect ratio of 1:10. Channels were added between wells to reflect interpreted channel movement through the embayment to correspond to the presence of similarly sized channels or lack thereof in nearby wells.

DD'

The wells in cross section DD' were selected to help tie the dip cross sections together (Figure 26). DD' runs 190km from Gonzales County in the southwest where it is 230m, to Brazos County in the northeast where it is 250m thick. It is located updip in the embayment to contrast how strike oriented depositional environments change in respect to the same environments in cross section EE', located more downdip in the embayment (Figure 27). For exact well identification numbers and locations see the appendix.

The Middle Wilcox in D-D' shows a slice through the Yoakum Canyon, present in well 2D. The canyon fill is 350m deep and dominated by mudstone with one 35m sandier unit present near the top. This view of the canyon fill matched descriptions provided by previous workers (Dingus, 1990; McDonnell et al., 2008). The Upper Wilcox fill thickens to a depth of 315m over the canyon.

Sequence 1 begins above the Yoakum Shale, delineated with a red MFS line in Figure 26. In the southwest well 1E shows 10m of prodelta mudstones overlain by 10m of an upward coarsening sandstone deposit interpreted to be representative of a delta/shoreface environment. Well 2E displays a prodelta mud and delta/ shoreface sandstone sitting over the depressed Yoakum Canyon fill. These non-terrestrial units are present considerably more landward than any other non-terrestrial facies in Sequence 1 (Figure 28.D). Well 3E shows the Upper Wilcox depositing a thinner, 8m, set of delta/shoreface sediments on the northeastern lip of the Yoakum Canyon. Between well 3E and 4E the non-terrestrial signatures give way to a muddy delta plain environment that makes up all of the sequence's 15m thickness in well 4E. The delta plain deposits get overridden by alluvial plain deposits that continue to the northeast where they make up all of the 12m of Sequence 1 in well 5E. The first channels of this cross section are present here but are very small in respect to the channels that are present in the ensuing sequences. The rest of Sequence 1 maintains thickness at 25m and is solely composed of muddy alluvial plain deposits interspersed with small sandier channel units.

The second sequence begins in the southwest with a 30m unit of upward coarsening sandstones that lie on 8m of prodelta muds. Well 2D shows a thick alluvial plane deposit that was largely interpreted by nearby wells and their respective environments. Channels in Sequence 2 in well 3D are mid-sized (3-8 m) channels incised into the muddier alluvial plane and floodplain/overbank muds that constitute the rest of the section in the well. Fluvial channels are considerably thicker in well 4E dominating the background alluvial plain and floodplain/ overbank deposits. These channels form the main fluvial axis in the embayment during Sequence 2, as can be seen in Figure 29.A. Channel thicknesses diminish to medium-sized to the northeast in well 5D that has background facies of alluvial plain and estuary deposits capping the sequence. Alluvial plain deposits dominate the rest of Sequence 2 in the northeast of the embayment with only medium to small channels present in the preserved sediment.

All of Sequence 3 in DD' is composed of non-marine facies indicating that the embayment that provided non-terrestrial signatures in the lower sequences has moved basinward from this cross section's position in the southwest of the embayment. A preponderance of small, ~2m, channels in well 1D make the underlying and incised delta plain facies hard to discern. The prevalence of these channels continues into the lower half of well 2D. The Upper 40m of well 2D is composed of floodplain/overbank muds and an upward fining that is interpreted to have been deposited in an estuary. Well 3D begins with 30m of delta plain which is overlain by 8m of floodplain/overbank deposits and then 15m of alluvial plain deposits. The channels present here are considerably larger and simultaneously less frequent than the channels observed to the southwest. These channels and the channels present in well 4D make up two branches of the main fluvial axis present during Sequence 3 (Figure 30.D). Well 4D is mostly composed of muddy alluvial plain deposits with 8m of estuary deposits at the top. To the northeast, well 5D has a series of medium to small channel bodies incising into delta plain environments that are capped with a 12m sharp based estuary deposit. Overbank/ floodplain muds dominate well 6D with a few small channels incising into the muddy matrix. Well 7D shows a uniform 40m section of muddy alluvial plain deposits.

Sequence 4 is dominated by floodplain/ overbank mud deposits with some alluvial plain and estuary deposits all punctuated with channel fills. Well 1D hosts some of the largest channels in the sequence overlain on floodplain deposits, also observable in Figure 31.D. Large channels continue to the northeast into the lower half of well 2D, the top 40m of which is composed of undifferentiated floodplain/ overbank deposits. Well 3D only has two small channels that incise into alluvial plain deposits. Small and medium channels once again incise into floodplain/overbank deposits in well 4D, this relationship can be seen in the lower left of the outcrop in Figure 35. Channel size increases significantly to the northeast in well 5D and then thins back to medium and small channels in well 6D. Only two small channels are present in the 30m of alluvial plain deposits in the furthest north well in the cross section, 7D.

The fifth sequence is dominated by prodelta muds deposited by the Reklaw transgression that culminated in the Reklaw MFS in red at the top of the Upper Wilcox classic wedge. Wells 3D to 5D all have sharp based sandy units that are interpreted to have been deposited in estuary environments.

Cross Section DD' shows an overall dominance of alluvial plain and floodplain/ overbank environments with a number of large fluvial systems incising into the substrates. There are some delta plain and delta/ shoreface depositional environments present in DD', generally in the southwest of the Houston Embayment. These environments reflect the embayed nature of the lower sequences over the Yoakum Canyon region prior to the progradation of the shoreline seen in Figure 23. By following the lateral changes through time of the large channel bodies in DD', the evolution and movement of the main fluvial systems of the Upper Wilcox can be tracked through the updip regions of the Houston Embayment.

EE'

The wells in cross section EE' were selected to help tie the dip cross sections together. EE' runs 165km from Lavaca County in the southwest where it is 380m thick over the Yoakum Canyon, to Waller County in the northeast where it is 200m thick. It was located downdip in the embayment to contrast how strike oriented depositional environments change in respect to the environments in cross section DD' located updip in the embayment. For exact well numbers and locations refer to the well list in the appendix.

The Yoakum Canyon is the most visible feature in the Middle Wilcox clastic wedge presented in EE'. The canyon shows 300m of mud in well 1E and 225m of mud with five small, <10m, sandstone bodies in well 2E. This mud dominated canyon fill with occasional sandstone lenses is what has been observed by previous studies (Dingus, 1990; Dingus, 1987; McDonnell et al., 2008). Canyon fill gives way to un-incised Middle Wilcox sediments (Calvert delta) between wells 2E and 3E (Xue & Galloway, 1995). The Middle and Upper Wilcox clastic wedges are separated by the Yoakum Shale (Hargis, 1996; Xue & Galloway, 1995), seen in red as a regional MFS in Figure 27.

Sequence 1 begins with prodelta and delta/ shoreface log signatures in well 1E. These coarsening up packages of sandstone and mudstone clearly indicate that sediments were being deposited into standing water in Yoakum Canyon region at the beginning of the Upper Wilcox. These non-terrestrial signatures continue through well 2E and are eventually overrun by delta and alluvial plain deposits in well 3E. There are three small channel bodies in the 30m of delta plain deposits in well 3E making this point the most basinward reaching position of the fluvial systems in Sequence 1. Prodelta and delta/ shoreface deposits re-enter the cross section northeast of well 3E with a 25m upward coarsening sandstone body in the base of 4E. The sandstone and prodelta mudstone continue through well 5E and then pinch out under delta plain deposits that are punctuated with a series of medium size channel deposits in well 6E. The last well, 7E in the northeast, is dominated by a series up 10m upward coarsening sandstones interpreted to be delta/shoreface deposits.

The second sequence in well 1E, at 100m, is twice the thickness of Sequence 1 in the same location. This fill is composed of six distinct delta/shoreface sandstone bodies ranging in thickness from 2-25m interspersed with prodelta muds. The prodelta muds dominate wells 2E and 3E moving to the northeast, with a few delta sandstones from well 1E pinching out slightly after well 2E. Well 4E shows the reintroduction of delta/shoreface sandstones as the cross section re-encounters a deltaic system (Figure 29.D). There are eight delta/ shoreface sandstones stacking with prodelta muds to make the 100m of sediment in well 4E. Delta plain log signatures dominate the 40m of Sequence 2 in well 5E along with five medium to small channel deposits. Well 6E has three small channels cutting into the constituent alluvial plain facies. The most landward extent of the regressive shoreline retreats behind the position of well 7E in the second sequence, where 100m of delta/shoreface sandstones and thin prodelta muds make up the sequence.

Sequence 3 begins with 10m of upward coarsening sandstone that appears to have been prograded over with channel bodies and a delta plain facies. The rest of the sequence here is composed largely of blocky sandstone bodies that collectively reach almost 80m of thickness and are interpreted as an incised valley (Gibling, 2006; Plint & Wadsworth, 2003). The delta/ shoreface log facies capped by delta plain facies continues to the northeast through well 2E where 5 large channels and one small channel show the downdip location of the largest fluvial channels in the third sequence. These channels thin and retreat into well 3E, with delta sandstones and delta plain facies dominating the sequence at this location in the embayment. A swarm of 2-5 m channels lies in the lower half of well 4E cutting through delta plain environments showing a second, smaller fluvial axis in the third sequence. Prodelta muds and sandstones fill the rest of the sequence to the northeast in wells 5-7E, indicating a landward stepping of terrestrial facies that were present at this location in Sequence 2.

An embankment wide progradation occurs between Sequences 3 and 4 over the location of EE'. There is only one well with delta/ shoreface or prodelta facies present in EE' in the fourth sequence, instead it is dominated by alluvial plain, floodplain/overbank, and channel deposits. The largest channels of the sequence are in wells 1E and 2E, incising into alluvial plain deposits that exists between floodplain/ overbank muds. These 9-17 m channels show the location of the largest fluvial axis during the fourth sequence in the downdip region of the embayment. Wells 3E and 4E are dominated by a high gamma-ray response indicative of floodplain/overbank deposits that have small to medium fluvial channel bodies incising into them. Alluvial plain facies takes over between 4E and 5E continuing into 6E. This region has a scattering of 2-6 m channels incising into the alluvial plain environment. The final well, 7E shows the only non-terrestrial signatures, prodelta muds with a small sandstone body capping them.

The downdip deposits of Sequence 5 are generally dominated by the prodelta muds deposited behind the regional transgressive Reklaw event. There is one major sandstone body present in well 4E that is interpreted to have been deposited in an estuary. The Upper Wilcox is capped by the Reklaw condensed section marked with a red MFS line in Figure 27.

This strike oriented cross section in the downdip region of the embayment highlights the repetitive interactions of terrestrial vs non-terrestrial facies through the Upper Wilcox. Non-terrestrial units make up the majority of the deposits in the southwest in the region over the Yoakum Canyon. This embayment above the canyon can be seen in the maps presented in Section 3.2. The fourth sequence shows almost an embayment wide regression past the wells that make up EE'. This basinward movement of delta/ shoreface depositional systems across the whole Houston Embayment occurs only after the local embayed shoreline over the Yoakum Canyon reaches a roughly linear or equilibrium state with the rest of the regressive shoreline between Sequences 3 and 4.

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Vita

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